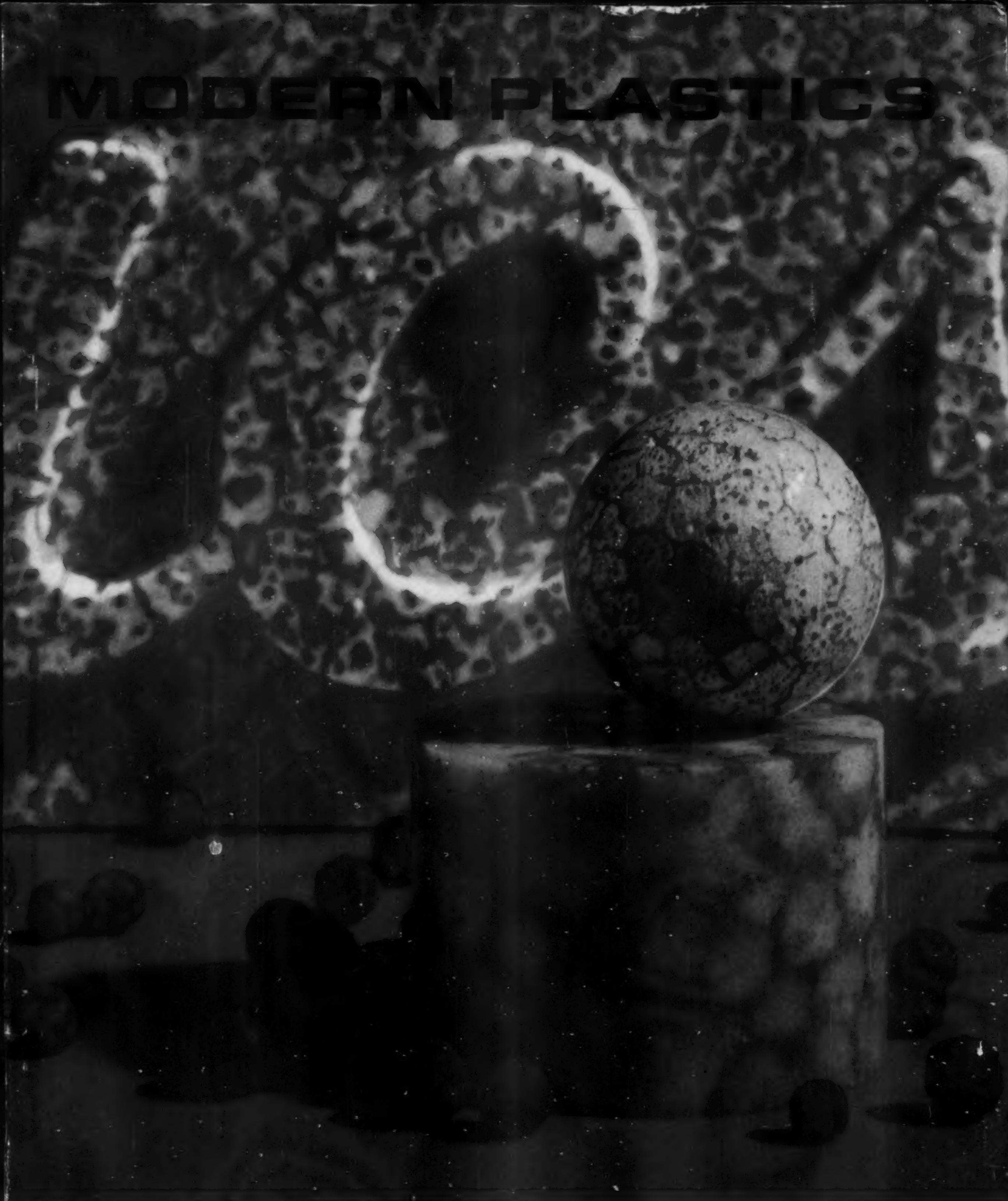
MODERN PLASTICS



DESIGNED AND PHOTOGRAPHED FOR MODERN PLASTICS BY RUDY MULLER

JULY 1961

Report from overseas

Interplas-61

London June 21-July 1

Europlastica '61

Ghent June 16-25

THE 9TH National Plastics Exposition in the United States closed June 9th in New York. In a special supplement to the June issue of MODERN PLASTICS we reported on the New York show. This report covers the highlights of the two shows last month in Europe.

Interplas-61

In the great, tall, glass-roofed halls of Olympia, London, England, was presented one of the best, and certainly, from an attendance standpoint, one of the most truly international plastics shows in history.

There is a vast difference between this and plastics shows as developed in the United States and elsewhere. First, this show lasts ten days, and whole sales forces, with attendant stenographic, telephone, and teletype services, move into Olympia and do business there. Second, some "stands" or booths in the main halls are two stories high, containing conference rooms, bars, and luncheon facilities – replacing evening entertainment suites of New York and Chicago. A

stand may cost in construction twice or three times as much as booths at American shows. From the moment the Guards, in plumed golden helmets, do their fanfare on their golden trumpets, to the late evening when the last stand attendant grabs a bus for home, this show is a thousand-ring circus.

Organized and promoted by "British Plastics" magazine, and held under the dignified and sincere auspices of the British Plastics Federation and the Plastics Institute, the International Plastics Convention for 1961 featured the thermoplastics materials, their markets, and the methods of processing them.

Two unusual events took place during the Interplas-61 show: the International Design Competition and the presentation of the Swedish Plastics Manufacturers. In the design competition, design experts of 11 nations selected their best national efforts in design of plastics products. All were displayed in one "stand." The winner: Max Braun, Frankfurt am Main, West Germany, for a combined transistor radio and record player in styrene, measuring 10" x 6" x 1½".

The Swedish presentation involved a reception plus a stand at the show. The theme was "Sweden comes to Britain" and the project featured products and processes of the Swedish Plastics Federation. An innovation, this idea may be copied by other national plastics groups at shows in the future.

What was *new* at the Interplas-61 show? In applications not a great deal. In machinery plenty!

Machinery and equipment

It was in new machinery and method that the Interplas-61 show shone. In injection molding, as was the case at the show in New York, screw preplastication is now the order of the day. And there seems to be a dual trend towards bigger injection machines and much smaller ones.

R. H. Windsor Ltd. showed a new line of fully automatic preplasticating machines with shot capacities from 1 oz. to 210 oz. and extruders with outputs up to 500 lb. per hour. The new Windsor A.P. 200 machine features a revolutionary type of transfer injection system declared to insure that the material, after preplastication, is delivered to the molds in perfect condition. Another new Windsor machine, the A.P. 30/155, uses twin-screw, in-line preplastication, which prevents feedback of material during injection pressurization. The Windsor S.P. 7 is a 4-oz. machine for high, fully automatic production, with a clamping force of 80 tons.

Peco Machinery Sales (Westminster) Ltd. featured their line of six Rotothrust machines, from 2 oz. to 178 oz. screw preplasticated, with universal single screws and heads, built to provide increased torque for the newer, tougher materials with no increase in wear on the thrust bearings. This is accomplished by the use of an hydraulic "cushion" which takes up the thrust load. Gears are eliminated.

Peco also showed a new version of the Euromatic blow-molding machine, with capacities up to 1 gal., linked to a 17:1 L/D-ratio extruder.

Francis Shaw & Co. Ltd. offered new 3½-in. and 4½-in. extruders specially designed for pipe extrusion. Their newest baby is a ½-oz. or 14-g. hydraulic injection-molding machine operating at 3 shots per minute. As other extruder makers, Shaw uses the "open" system of construction so "the guts are get-at-able."

Churchill Instrument Co. Ltd. showed a new ¾-oz. automatic injection machine capable of turning out 1600 shots per hour. It is hydraulically operated and has very high injection pressure. It is designed so that it may be used horizontally for automatic production or vertically for insert work.

Buhler Brothers, Switzerland, showed the Rover models, 175 and 350, the first a 16-oz. machine, the second rated at 35 ounces. Screw preplasticated, these machines, soon to be made in the United States, have been tested out on rigid vinyl, polycarbonate, and ABS polymers in thick and thin sections.

B.I.P. Engineering Ltd. offered two new Bipel automatic injection machines, with screw preplastication and hydraulic clamp. One is rated at 4 to 6 oz., the other at 4 to 8 ounces.

An interesting line of miniature injection machines was shown by the Small Power Machine Co. Ltd. These machines are air-operated vertical units, with

added hydraulic power units, mainly for bench use in laboratories and schools.

Still another tiny injection machine, a 1-oz., fully automatic unit, was offered by Asmidar Plastic Moulding Machines Ltd.

T. H. & J. Daniels exhibited a huge new 250-ton, low-pressure press for reinforced plastics and laminating work. Platens up to 12 ft. long and 5 ft. wide were in use on this machine.

Duplex S.A. had working the new S CO/85 automatic screw injection machine with a removable hopper for easy cleaning, which is reported to run 17 shots/min., dry cycle. Rated at 2 oz. single shot, 3 oz. double shot.

Turning to other types of machines, Baker Perkins Granbull Ltd. had the biggest machine on view. It is a blow-molding machine capable of turning out 40-gal. containers. Model No. 53 is used with a 3½-in. (89-mm.) extruder.

Dimon (England) Ltd. showed a Samafor blow molder specially designed for bottle work. It is claimed to work on vinyl as well as polyethylene.

One of the most interesting new extruders was the Oerlikon Plastics Ltd. Rotatruder which extrudes vertically upwards blown polyethylene tube. The whole machine oscillates 360° every three minutes, eliminating thin spots in the film and preventing wrinkles.

For Formvac Ltd., Switzerland, John Kimbell & Co. Ltd. featured a new machine, the Formseal, which forms packages, fills them, and seals them. It handles all kinds of thermoplastic films, even boilable types.

Foster, Yates & Thom Ltd. had on view a larger, automatic version of the machine which extrusion-molds vinyl shoes and other items by low pressure.

London and Scandinavian Metallurgical Co. Ltd. introduced a new version of the Losca rotational casting machine and showed a new method of making molds for blown articles.

In specialized equipment, Radyne Ltd. showed a new series of electronic bonding presses, the Series W/4P, including fully automatic versions with a wide range of loading frames and progressive feeds.

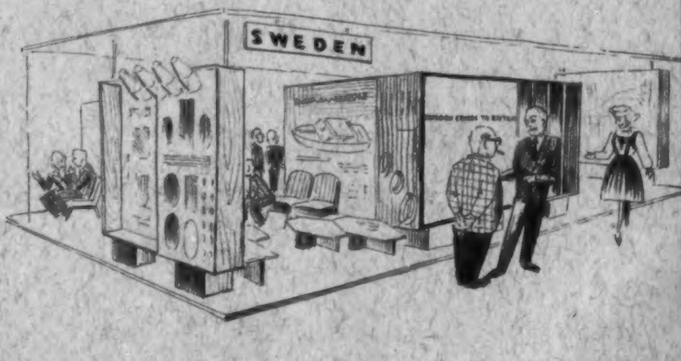
Guyson Industrial Equipment Ltd. showed a new line of tumbling units and de-flashing machines, in particular one, the SBP/40, for closed-box treatment of individual moldings. The operator sticks her hands through a rubber face and views the operations in the machine through a safety window.

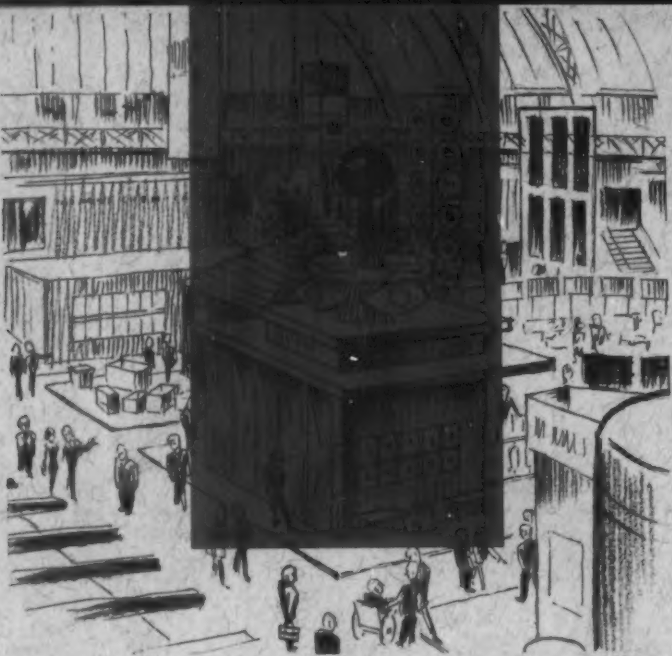
There was more – much more. Take-off equipment, sprayup equipment, metal-coating machines. In the months to come MODERN PLASTICS will report in detail on these developments.

Materials applications

In terms of applications and use of materials the pattern was much the same as at the New York show, with a few major differences. Examples:

- Boats made of bonded rigid vinyl sheets (British Geon) with closed-cell rigid vinyl foam for flotation.
- Rigid vinyl microgroove records injection molded on an Ankerwerck machine.
- Displays, statuary, toys slush molded from Vinatex (a Reichhold affiliate) rigid vinyl plastisols. Fluidized bed coatings and sintered products up to 17 ft. by 7 ft., by Plastic Coatings Ltd.
- Subminiature injection molded parts (nylon, acetal, polycarbonate, etc.) in multi-cavity molds by Geo. Goodman Ltd.
- A mass-produced reinforced plastics relay room, along the lines of the House of the Future in Disneyland, built by Mickleover Transport Ltd. for the British Railways, featured at the Glass Yarns and Deeside Fabrics Ltd. stand. Made in four pieces, with polyester stems and foam phenolic core, the parts are bolted together. Sizes range from 14 ft. to 28 ft. square.
- The production of very heavy net fencing in vinyl and high-density polyethylene or polypropylene by the Spicers Ltd. Netlon process (Du Pont is a licensee), already big in fruit packaging.
- A new system for making decorative polyester-fibrous glass laminates by E. & H. Universal Laminated Plastics Ltd. Designs, including marbles, are handprinted directly on the mat with compatible inks. Resin is added. Pressing is at very low pressures.
- Television backs produced with vast economy from a wet slurry of cellulosics with phenolic resin by Fibre Form Ltd. Dense, light in weight, they can be painted or covered with anything approved for both tropical and arctic use in luggage, instrument panels, etc.
- A new version of the P 1 rocket launcher, built out of reinforced polyester by Microcell Ltd., shoots 37 rockets at once.
- Fantastic savings in the production of dials, kitchenware handles and instrument faces in melamine and phenolic by use of molded-in decorated foils by Ornamin (U.K.) Ltd. Eliminates hobbing, permits use of multi-cavity molds, releases decorating staff for other operations.
- The to-be-famous Vent-Axia ventilator fan molded by Streetly Manufacturing Co. Ltd. Has parts of melamine, acetal, ABS polymer, phenolic.
- Lifeboats, water tanks, flanged watertight marine doors, cowl ventilators, port-light boxes for ships by Watercraft Ltd., of reinforced plastics.
- Parts tooled out of million-molecular-weight polyethylene at the Farbwerke Hoechst stand. Textile bobbins, gears, bearings. Almost indestructible.
- Nylon 11 (Rilsan) cook-in-the-package pouches at the stand of Felber Jucker & Co. Ltd.
- New colored gel coats by Ferro Enamels Ltd.
- Raffia for the furniture trade made from high-density polyethylene at the Kleestron Ltd. stand. Tested for exterior use in all climates.
- Injection-molded refrigerator interiors by Ekco Plastics Ltd., up to 5 cu. ft. in size.
- Packaging of a newspaper in polyethylene at a





rate of 30/min. by U. S. Industrial Chemicals Co.

● Proof at the stand of the London School for the Blind that blind people can run modern automatic injection presses quite as well as people with sight. Quality control by Braille is amazing.

● The I.C.I. emphasis on plastics in building, with ABS piping, electrical conduit, toilet cisterns or tanks, vinyl gutters, acrylic baths and basins, vinyl window frames, all used in an actual building.

Over 115,000 people attended Interplas-61. Over 10,000 from beyond the British Isles.

Europlastica '61

In a suitable hall in a lovely park in the charming, ancient, and clean city of Ghent, Belgium, was promoted an ineptly-managed plastics show.

Highly touted as a show for the European Common Market, this show – in booth signs, in literature available, in publicity – featured but two languages: French and Flemish, in that order. No German, no Dutch, no Italian, no English. Manning most of the booths were junior-grade salesmen from Belgian and French distributing organizations who knew little.

The associated conferences seemed not to have much to do with plastics, nor to be sponsored by internationally recognized plastics societies. One meeting, under the aegis of the Applied Linguistics Foundation, dealt with the development of "multi-lingual plastics dictionaries and word-lists." Another, at which nothing really new was offered, was concerned with plastics in building construction.

The management of this Ghent Show, highly successful and well-reputed in machine tool expositions, proposes to run another show (Europlastique) from May 19 to 29, 1962, in Paris, France, under the "high direction" of twenty French plastics societies and associations. It is to be hoped that the management will learn something about the plastics industry and its objectives elsewhere before establishing a format for this proposed show.

Nevertheless, it is impossible to stage any plastics show without exposing some new developments.

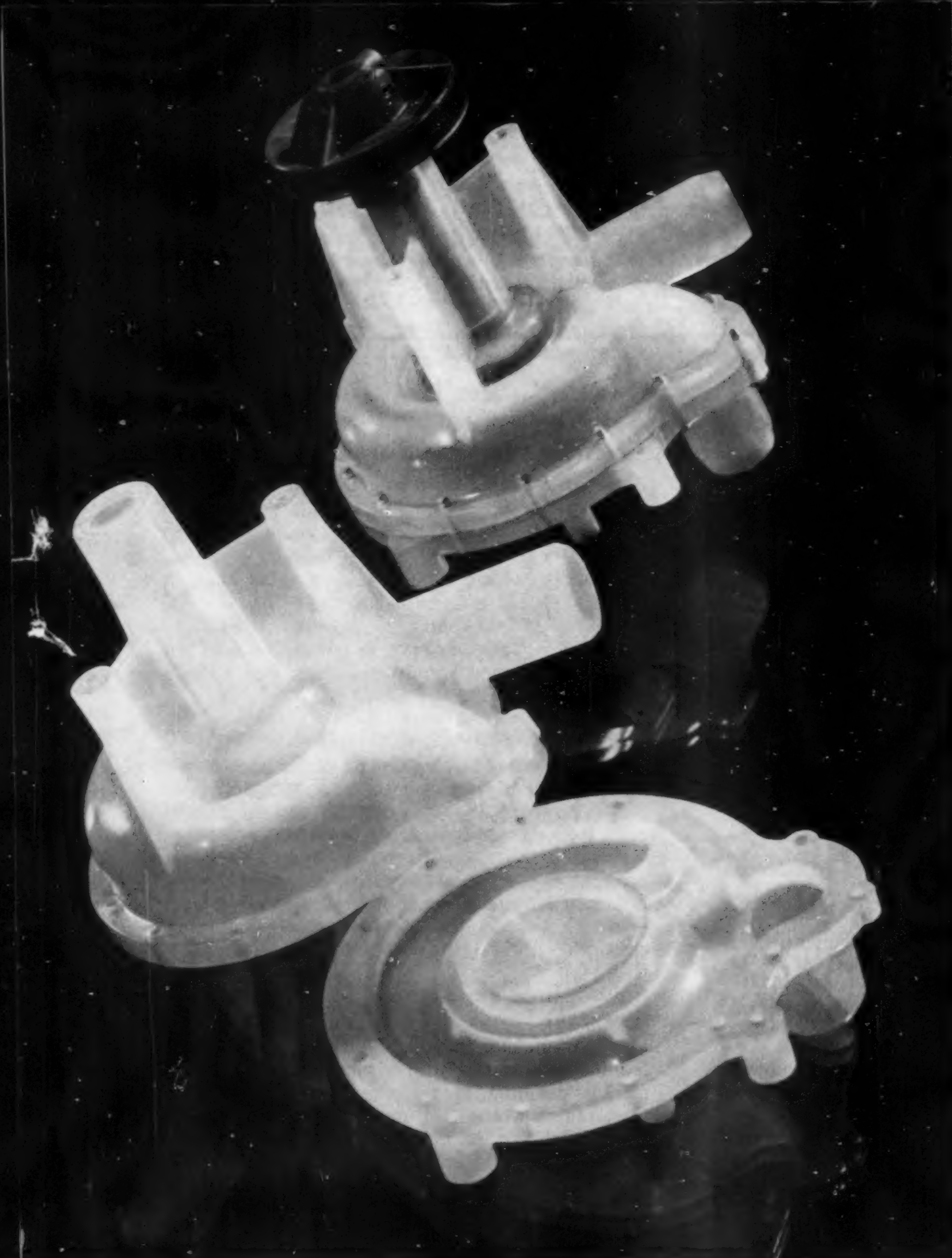
Usines Rubbens S.A., Lokerens, Belgium, exhibited reinforced plastics water tanks for locomotives, made by spraying polyester resins on woven fibrous glass roving in epoxy molds. They test out at high burst pressure and can be guaranteed for two years. Another series of tanks, made by Plasticon, Oldenzaal, Holland, is made by filament winding of loaded roving on a glass fabric base.

Metallic and pearlescent acrylics were featured by Altulor, Paris, France, plus hollow doors of acrylic with plastic plants and flowers in the sandwich. Ateliers de Forest, Brussels, showed semi-transparent doors made from acrylic moldings in plaids, checks, metallics, and other decorative effects.

Many versions of injection-molded chairs were shown, mostly high-density PE and propylene, notably some made from material provided by Solvic in Brussels.

Organico, Paris, featured the first wine bottles blown from Nylon 11. Ornapress, A.G., Zurich, Switzerland, showed how the foil decoration of melamine moldings may be carried beyond dinnerware and into knobs, dials, and marked industrial parts. Decorated polyester-fibrous glass trays were numerous and fabulous.

As to machinery, Martin Rudolph, Velbert, West Germany, offered a huge blow-molding machine capable of making containers up to 125 gal. in size. Tavannes Machines Co. S.A., Switzerland, had a new automatically indexed compression press with 10 stations, of 15 tons pressure each, for the molding of large electrical parts. Jean Facon & Cie., Paris, France, presented a huge new injection press. Samafor, La Courneuve, Fr., showed a new extruder. And two new sprayup guns were shown, one by I. Coudenhove, Vienna, Austria, one by Down Land Ltd., England. Both shoot glass plus resin, resin only, or glass only.



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POLYSTYRENE

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Maytag switches from metal to *Catalin* POLYPROPYLENE

Another step forward by Maytag* is a case in point where a good product was made better by adapting plastics to a key mechanical part. Formerly of metal, the pump housing in their coin-operated, commercial automatic washer took a day-in and day-out beating. The abrasive action of sand and the chemical action from the chlorine, both from the water supply and added to the wash water in the form of bleach, created maintenance problems.

The unique combination of polypropylene properties seemed the answer . . . and field tests proved it out. Now molded of Catalin Polypropylene, the new, rugged Maytag pump housing resists abrasion, corrosion, alkalies, detergents and stands up also to high water temperatures found in commercial laundry installations. Service life has been satisfactorily extended.

Catalin's complete range of molding, blow molding and extrusion compounds offers many such opportunities for product improvement. Inquiries invited.

**Pump housing custom molded for The Maytag Company by Artag Plastics Corp., Chicago 18, Ill.*

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MODERN PLASTICS*

Volume 38, Number 11 **July 1961**

• Coming up . . .

Our August lead, first in a series of articles, will take an over-all, close look at the mushrooming polypropylene field . . . Printing from photopolymer plates . . . How to achieve special color effects in plastics . . . New market for high-density polyethylene: beverage case . . . Custom extrusion as a design medium . . . Engineering lead: ultrasonic sealing . . . Technical lead: Glass Microballoons . . . Also in the works: Spray-up—new techniques, new markets . . . New developments in urethane foam . . . Industrial applications of filament winding . . . Unusual blow-molding techniques . . . Rotational molding of polyethylene powder.

New Address

Modern Plastics Executive and Editorial Offices: 770 Lexington Ave., New York 21, N.Y. Please mail all correspondence, change of address notices, subscription orders, etc., to above address. Quotations on bulk reprints of articles appearing in this issue are available on request.

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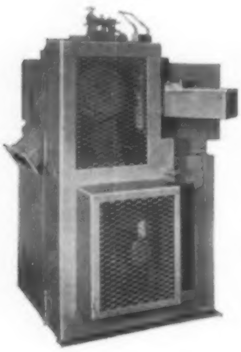
The greatest variety of plastics granulating, pelletizing and dicing machines ever offered. Machines of advanced design for every need from laboratory models to the ultimate in size and capacity.

Cumberland "Stair-Step" Dicing Machines



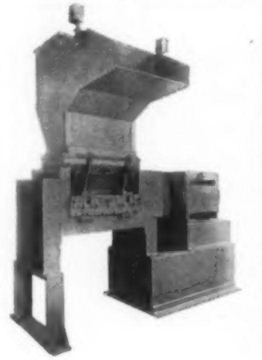
For dicing the *full range* of thermoplastic materials.

Cubes 1/16" to 1" produced from plastic sheet or ribbon stock. Pellet sizes altered merely by changing knives. Cubing is done in one severing operation with rotor knives cutting against one bed knife.

All surfaces contacting plastic materials are of corrosion-resistant metals.

Three sizes of machines for stock widths 3½", 7", and 14".

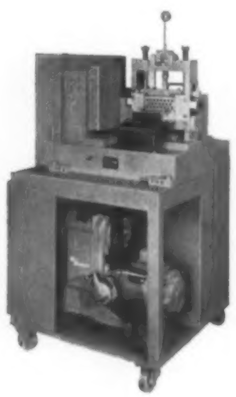
Cumberland Model 30 Granulator



A large heavy-duty machine for extremely rugged work, offered in throat sizes 11"x30" and 16" x 30". Optional number of knives on rotor and optional type of knife mountings. Pivoted doors provide ready access to cutting chamber for easy cleaning and adjusting knives. Screen is readily removable.

Frame and cutting chamber are of thick weldments with deep welds. Rotor and seal rings are heat treated and ground all over to provide tough, undamageable parts. Hardened surfaces preserve new appearance.

Cumberland Pelletizing and Straight Feed Dicing Machines



A full range of pelletizing machines with the following feed table widths: 6", 14", 17", 24", 28" and 42". Newly designed models to accommodate today's high input speeds and high hourly capacities.

Straight feed dicing machines are modified pelletizing machines known as the Cumberland Notched – Knife and Ratchet – Tooth Dicing Machines. They are less expensive though more limited in application than the Cumberland Stair-Step Dicer. These straight feed dicing machines have the same feed table widths as the pelletizers. They produce rectangles or cubes from extruded or milled sheet or ribbon stock.

Five Improved Cumberland Large Throat Granulating Machines

Large throat openings — 8"x10", 10"x12", 10"x16" 14"x16", 14"x20" — designed for use beside the press or for central granulating machines.

New knife design and slow rotor rpm provide better granulation, and at the same time yield quiet operation. Clean cutting is assured throughout the complete range of thermoplastic materials from softest polyethylene and vinyls to hard and tough nylon, ABS and acetal resins.

Quality construction, rugged as all Cumberland machines, is entirely of steel weldments. Advanced design leaves all working parts readily accessible for cleaning and adjustment of knives.

Minimum floor space. End removable screens.

Cumberland Laboratory and Pilot Plant Machines

A new 6" Pelletizer
A new 3½" Stair-Step Dicer
Granulating Machines O and 810

Cumberland New Extra Large Granulating Machines.

Four new machines, throat sizes 15"x24", 18"x28", 18"x37" and 20"x50" for bulky materials such as film, blow molded and vacuum formed items.

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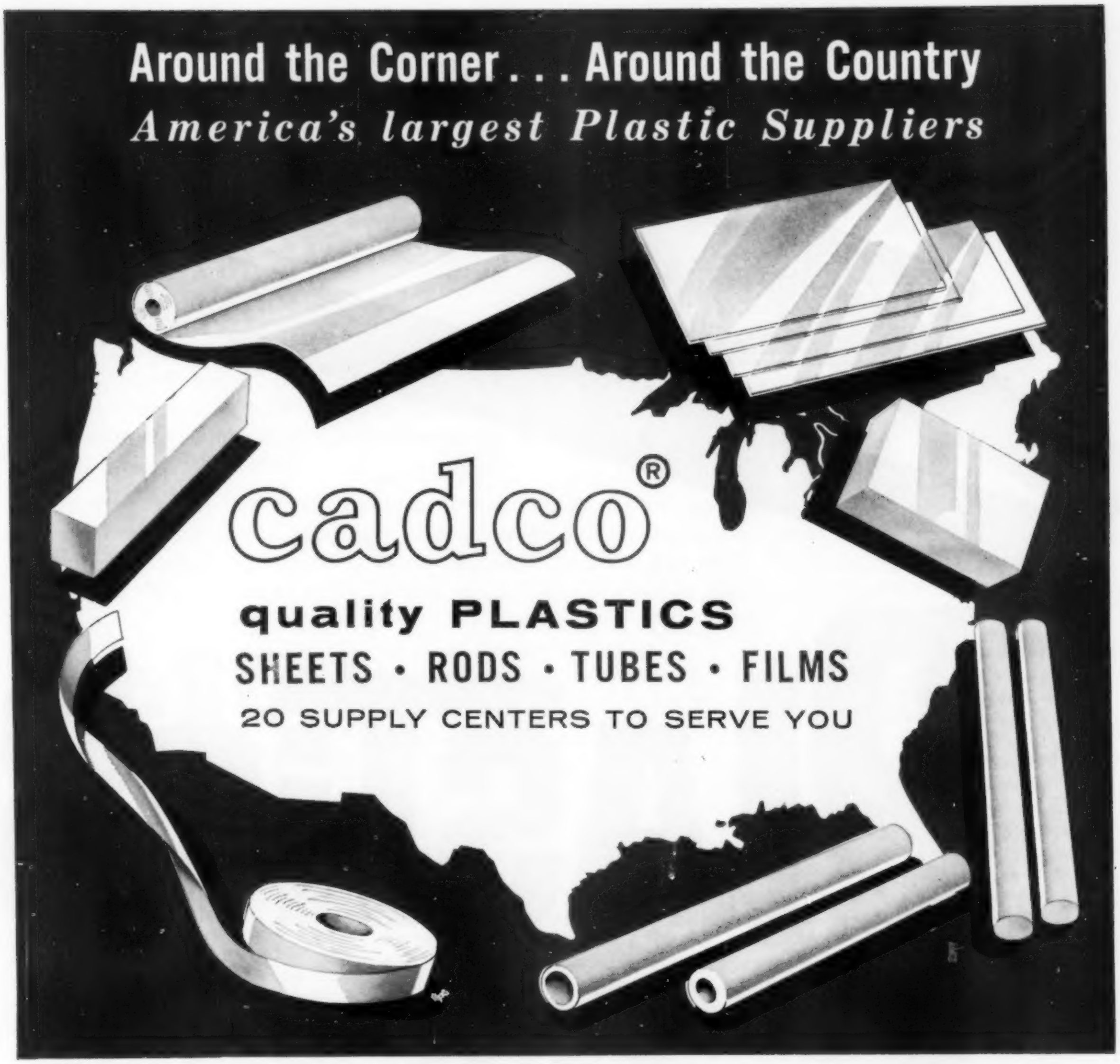

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These papers may be parchmentized, crinkled, supered, waxed, silicone-treated, etc. An existing KVP Releasing Paper will probably serve your needs—but if not, KVP Sutherland will work to create a special paper that *will*. The resulting new product will not only be ideal for your use—it will be economical.

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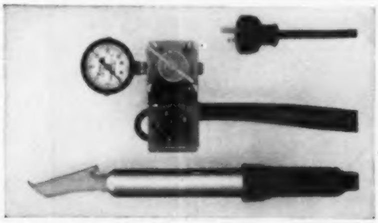
A series of advertisements for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

JULY, 1961 U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

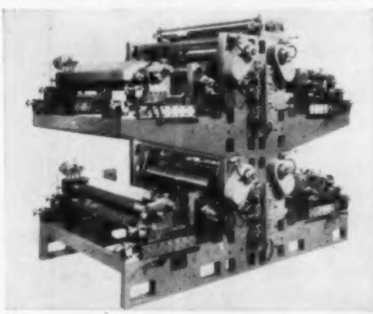
Paste spackling for patching cracks and nicks in plaster, wood and wallboard is now convenience-packaged in a ½-pint polyethylene tube. The manufacturer points out that easy, one-hand operation of the tube allows the user to keep the other hand free for spatula or putty knife.

Versatile hand-welder for polyethylene can be used for tacking or high-speed



welding at a production rate of 60 in. per min. Patented design maintains constant flow of high-temperature air through specially designed tips. Unit has a 3-heat metal element with an output of up to 800 watts and a 16-foot air-hose (with electric cable inside). Can be plugged into any 115 volt a-c outlet.

Expandable flexographic press permits the converter to add color units on a "building block" principle—lowering ini-



tial investment, yet allowing for future expansion. Side frames of additional units are merely bolted onto special prebored fittings within the existing frame.

This press is designed for use in in-line extruding and bag making, as well as roll-to-roll printing. It can print up to six colors, comes in sizes to accommodate web widths of 24 to 42 inches.

Polyethylene-coated cartons are now being used for chilled orange juice as well as milk. Leaking and flaking—shortcomings of wax-coated containers—have reportedly been virtually eliminated.

Polyethylene Film Extrusion Operators' Guide Issued By U.S.I.

New 56-Page Manual First of Kind to Be Offered by a Raw Materials Producer

"Polyethylene Film Extrusion . . . An Operating Manual" has just been published by U.S.I. The new 56-page booklet is the most complete and useful guide to efficient polyethylene film extrusion ever published. The first comprehensive manual prepared by a resin producer expressly for film extruder operators, it represents a major effort by U.S.I. to improve and standardize polyethylene film.

The booklet provides the extruder operator with everything he needs to know to make the best possible polyethylene film at the most efficient production rates. It distills the experience not only of U.S.I. sales and technical service departments, but also of many extruders themselves. It presents this information in easy-to-understand terms familiar to everyone — those who operate and maintain extrusion equipment, as well as their supervisors.

Pages 14 & 15 of U.S.I.'s new information-packed 56-page booklet which is available through U.S.I. salesmen.

First the Basics...

For workers new in the field, this manual provides such fundamental information as what polyethylene is, how it's made and how modifications of its basic molecular characteristics affect resin and end product properties.

A section on what happens to the polyethylene resin on its way through the film extruder follows. Included are simple diagrams of the extrusion machine and explanations of the functions each part performs.

Next come tips on how to open a polyethylene resin bag properly to save time and minimize contamination problems.

Then the Particulars

The core of U.S.I.'s new manual helps define the problems operators and maintenance men have to cope with and offers some practical solutions. Specifically there are chapters on: melting the resin; film cooling and frost line; the blown film bubble; take-off and windup equipment; checking and keeping a record of extruder controls; cleaning the extruder; means of increasing output and improving quality. The last contains a full-page table listing the most common defects in extruded film and their possible causes.

50 Do's and Don'ts

The booklet winds up with some basic safety rules and a checklist of some 50 Do's and Don'ts, which is also available as an 11" x 15" wall chart for posting near the extruder.

Copies of the operating manual and poster can be obtained through your U.S.I. salesman. Sales office branches are found in most large cities. Ask your U.S.I. salesman for your copy and extra copies for your plant operators.

Best in Show

This toy dog wins a blue ribbon for demonstrating a new and unique use of polyethylene film. It's cleverly fashioned by a Texas woman whose deft hands also transform polyethylene film into toy rabbits, Christmas wreaths.

The poodle comes in black, white or pastel colors. Model shown sells for approximately seven dollars.

New Blending Resin Introduced by U.S.I.

Development of a new injection molding blending resin, PETROTHENE 250 Polyethylene (density 0.926, melt index 250), has just been announced by U.S.I. Very high flow and ease of blending are its key properties.

It can be blended with lower melt index resins to improve their flow for injection molding or used alone for non-critical injection molding applications.

In trial runs at U.S.I.'s Polymer Service laboratories, items molded from blends of PETROTHENE 250 and lower melt index resins had physical properties superior to those molded from blends utilizing polyethylene waxes. Also, items molded from the straight resin exhibited very high gloss and good surface smoothness, as well as good stiffness and high impact resistance at room temperature.

POLYETHYLENE PROCESSING TIPS

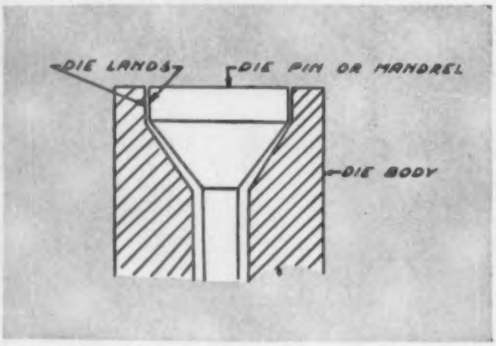
U.S.I.

Series VI, No. 4

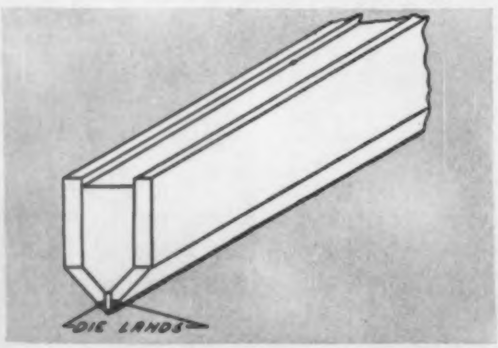
CARE AND CLEANING OF EXTRUDER DIE LANDS

In polyethylene film extrusion and extrusion coating, the die lands (see diagrams) must be kept clean and free from nicks and scratches. These are the final surfaces over which the hot melt passes before leaving the die, and which shape the hot plastic and help to produce smooth surfaces. Any surface irregularities in the lands show up as lines or streaks in the plastic. If severe, they weaken the film, but in any case, they are undesirable since they spoil film appearance.

Oxidized particles are a major cause of rough die lands. If proper care is not taken, small raised areas of oxidized plastic can form on the lands, marking the film as it passes by in the hot melt stage.



Location of die lands on blown film die.



Location of die lands on flat film and extrusion coating die.

Preventing Oxidized Polymer Build-Up

Oxidation is more of a problem in flat film extrusion (chill roll or water quenched) and extrusion coating than in blown film extrusion. That's because these require much higher temperatures, which promote oxidation. Care in shutting down the flat film extruder or extrusion coater will reduce the problem of oxidized polymer on the die lands. Simply shut off the temperature controls and let the hot melt temperature fall below 400°F before shutting off the screw.

Several other precautions will cut polymer build-up on the lands in all types of equipment. A simple method is to remove oxidized polymer daily, or more often, use a brass blade which is thinner than the die opening. The blade should be dull and have a rounded tip so it won't mark the hot lands. Insert it between the lands and push it along their length (or around their circumference, in the case of blown film). The blade should always be pushed around or across the entire surface of the lands—never in and out at one spot.

A second step in keeping die lands clean and smooth is to schedule a complete cleaning on a regular basis. How often is best determined through experience. In most cases, cleaning at least once a week is necessary.

Cleaning Procedures

In blown film extrusion, the die lands are a part of the die body and mandrel. Hence, in cleaning the lands, the entire internal die surface is cleaned as well. Following is the recommended procedure:

1. Remove die from extruder while it is hot.
2. Pull mandrel or die pin from die body.
3. Scrape excess polymer from die pin and die body with a soft metal (brass or copper) or wood instrument.
4. Remove the last bits of polymer with brass or copper wool.
5. Polish mandrel and internal surface of die body, using a very fine grit cleaner (2400 grit lapping compound is used at U.S.I.'s Polymer Service Laboratories) on a soft, damp cloth or tissue.
6. Give lands a light coat of silicone grease.

A similar procedure is followed for the lands of flat film and extrusion dies. First remove the die jaw while hot — but below 400°F. Next remove the die lands from the jaws if they are separate. Then clean the jaws and lands as in steps 3 and 4 above, and polish and coat the lands as in steps 5 and 6.

A Word of Caution

In cleaning and polishing die lands, *never* let a screw driver or other hard metal tools touch the lands; they cause nicks and scratches. *Always* clean and polish with smooth, even strokes in a direction perpendicular to resin flow; this eliminates the danger of rounding the die lips.

Cleaning procedures outlined above will substantially reduce the amount of off-quality film resulting from contaminated die lands. However, from time to time, the lands will have to be refinished either by honing or, if they are chrome plated, by replating. U.S.I. Technical Service Engineers can give you advice on these procedures.

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Division of National Distillers and Chemical Corp.
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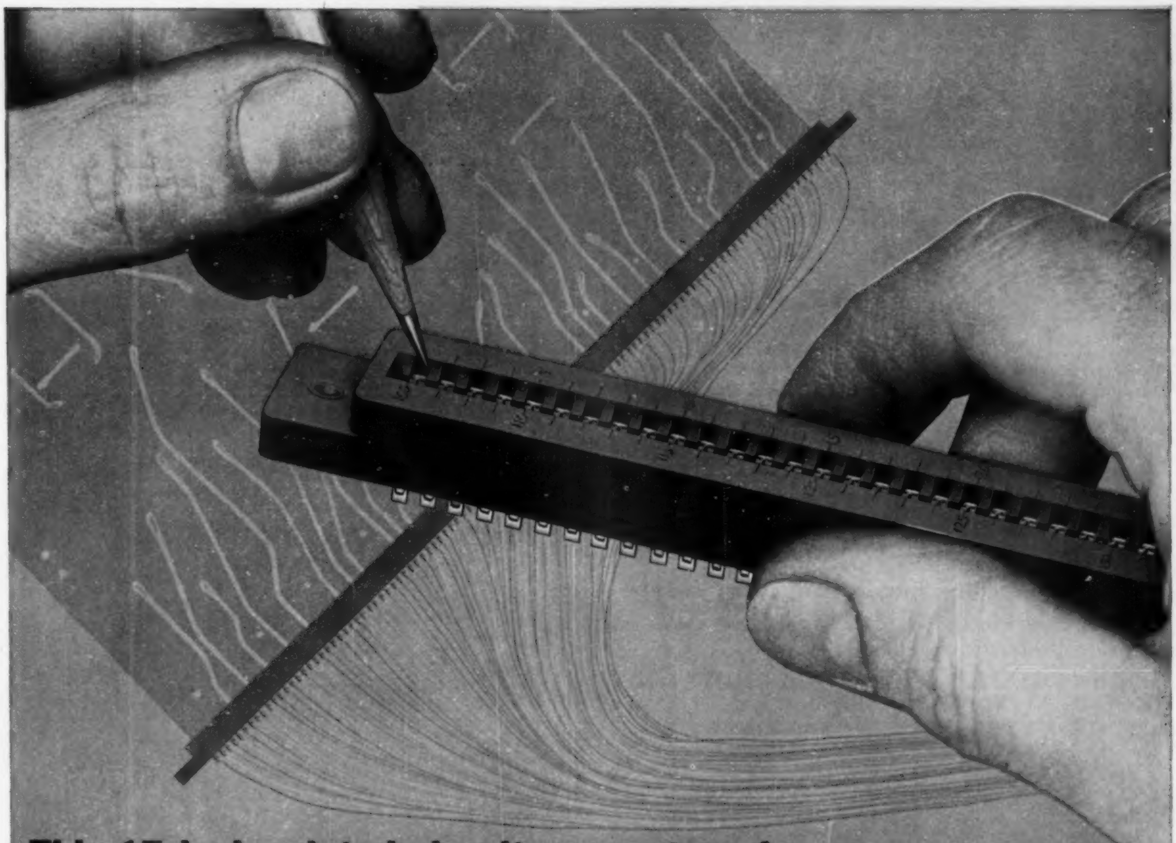

This 17-inch printed circuit connector of

DAPON® M OPERATES AT 450° F...
DIALLYL ISOPHTHALATE
STOPS WARPAGE AND MISALIGNMENT

Dimensional stability of compounds based on DAPON M keeps this connector straight and true: contacts are always accurately positioned.

This long connector is home base for hundreds of terminals. By molding it of thermosetting compound based on DAPON M, Viking Industries Inc. solved a number of design problems . . .

DAPON M gives the connector outstanding electrical and mechanical qualities. The resin permits 450°F continuous operating temperatures, has excellent dimensional stability and resistance to moisture. Its electrical resistance (measured in millions of megohms) remains unaffected by weeks of exposure to 100% relative humidity.

The material is easily molded. It has good hot strength, the piece is strong when cured. Neither cooling jigs nor multiple ejector pins are needed in removing the connector from the mold. Fast cycles are possible. The resin's high flex, tensile, and compressive strengths result in rugged moldings with high insert holding power and dependable performance.

DAPON M is recommended for use wherever:
- high operating temperatures are encountered
- top electrical qualities are a must
- better strengths are desired
- molding conditions pose a problem.

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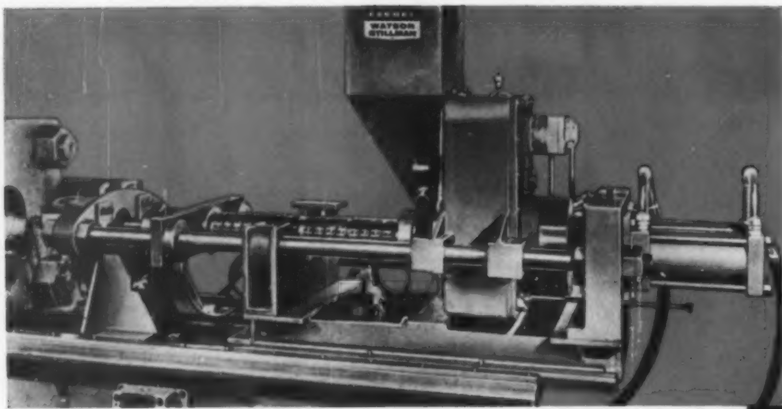


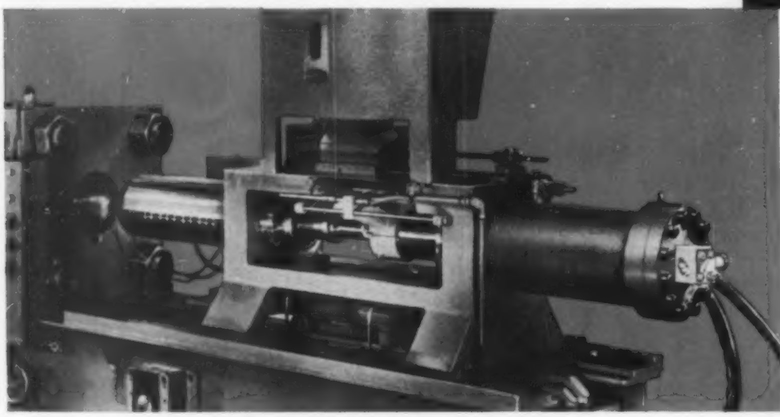
screw-type plasticizer

Here is a new machine designed for high product uniformity and strength and excellent color dispersion. Ideal for running heat-sensitive materials because they are worked mechanically. Can be supplied with three different screws for molding different materials.

These two new machines mean

selectivity unlimited

on your injection molding requirements



plunger-type plasticizer

All-new machine for molders requiring a normal straight-shooting machine of advanced design. Delivers high output with low cost and minimum maintenance. Will mold a great variety of products with excellent dimensional stability and fine surface finish.

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Suggestive of the unusual degree of selectivity available to you at Farrel Watson-Stillman are the two new 12 to 20 ounce machines illustrated. Each has advantages depending on the needs of the individual molder. The screw-type version, for example, assures high quality in molding the more difficult types of plastic materials . . . can be ordered with a choice of 41 optional features! The plunger-type machine has appeal for those interested in a normal straight-shooting machine.

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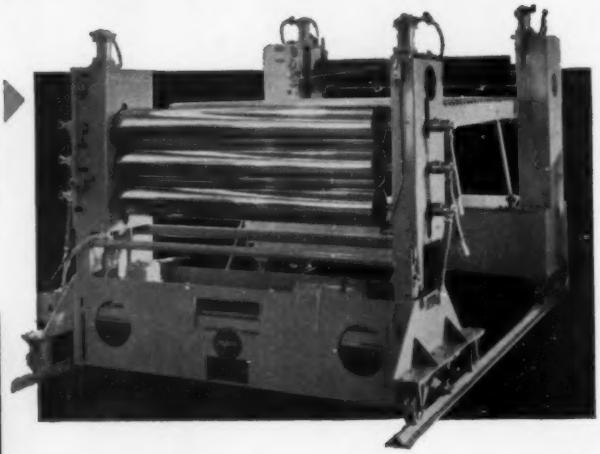

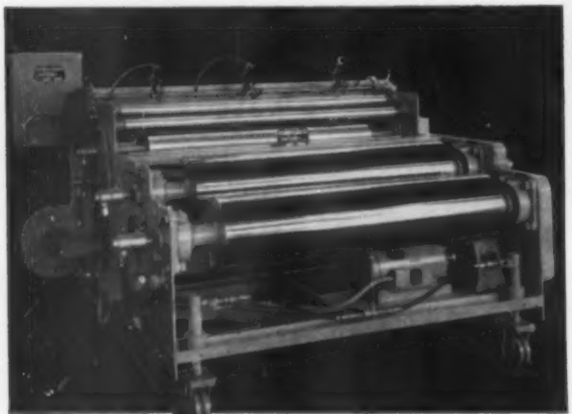

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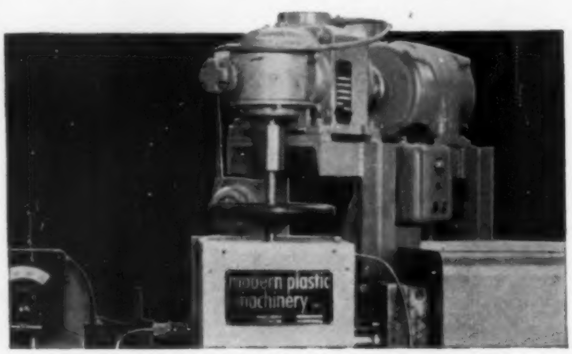

For more information on these and other MPM machinery, write for our new 16-page illustrated catalog and specifications sheets.

Modern Plastic Machinery Corp.

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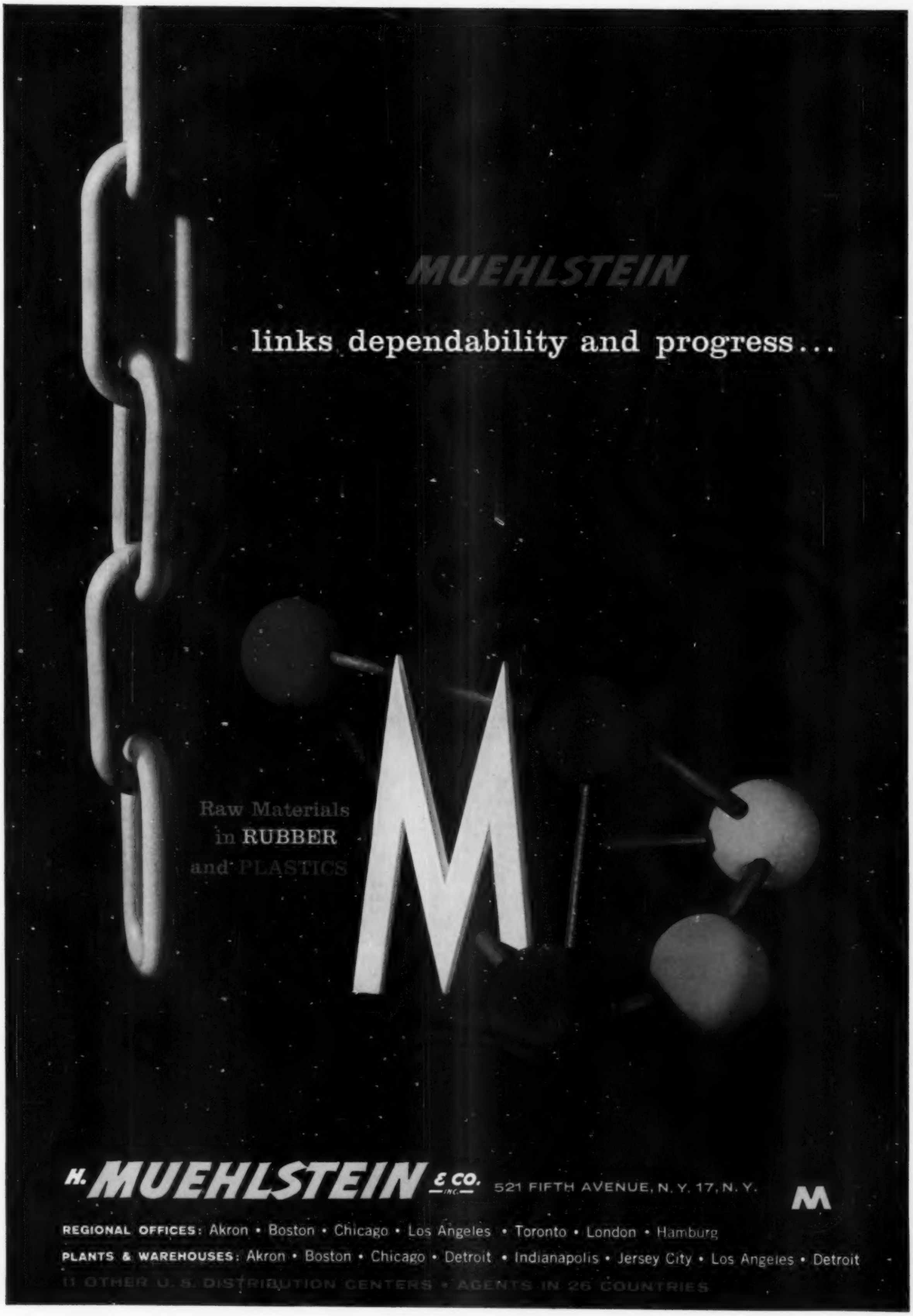

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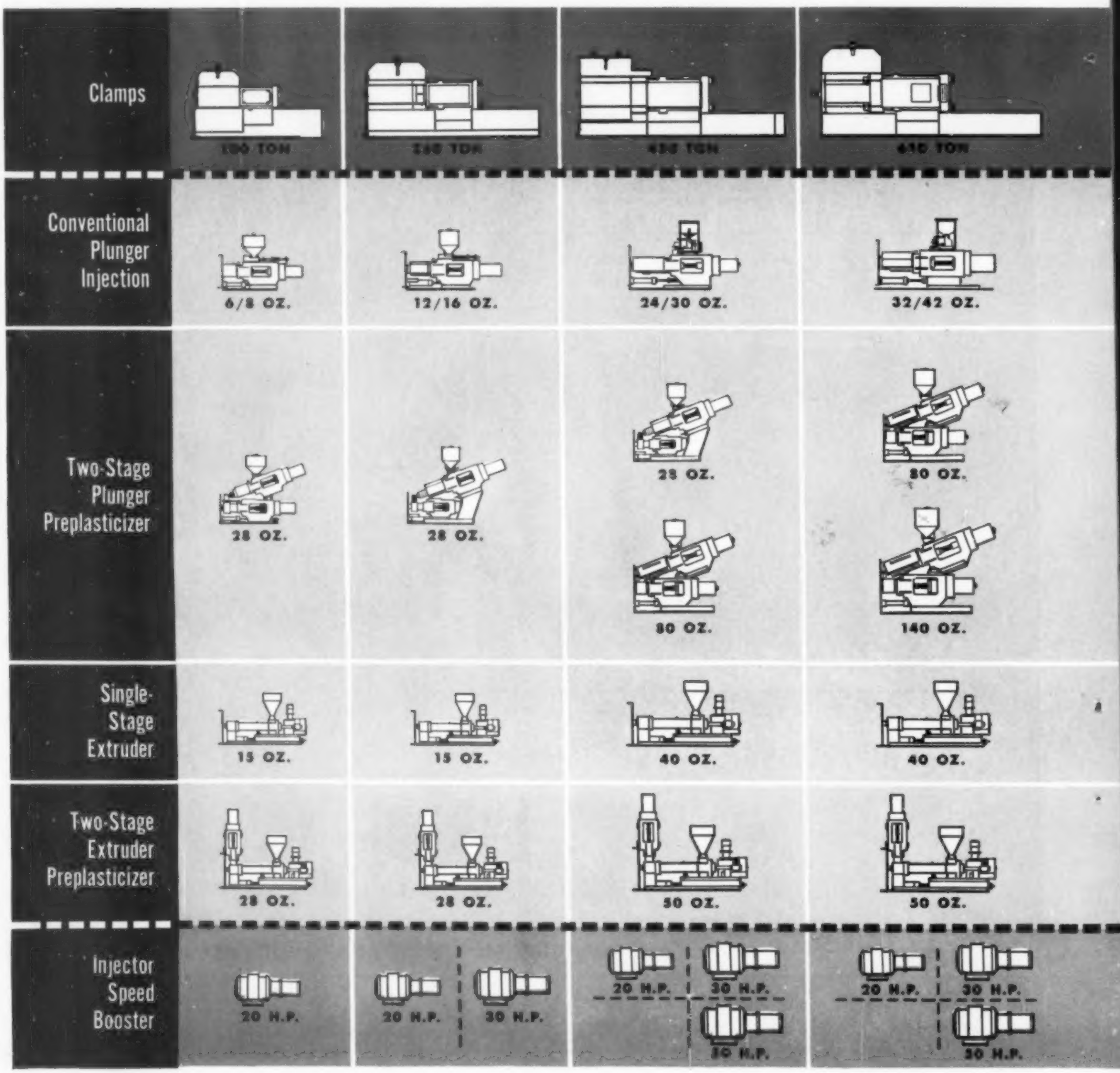

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Pre-engineered components with wide interchangeability broadens H-P-M's versatility. For new heat sensitive materials, for new applications, for faster production with absolute dependability, the H-P-M line offers most for you. There's an H-P-M "custom-designed" for your specific needs.

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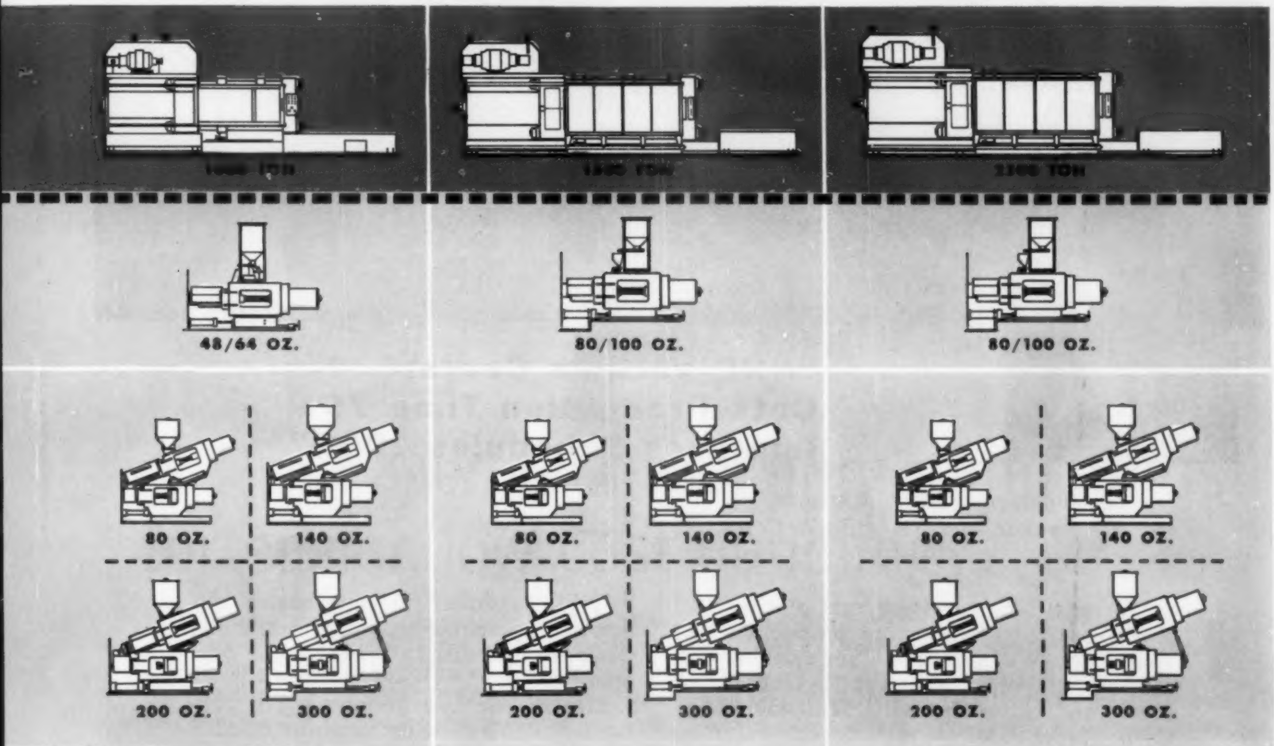

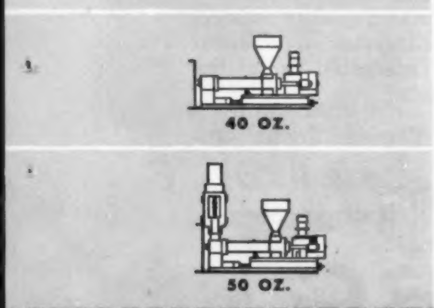

NEW H-P-M INJECTION MACHINE VERSATILITY

The H-P-M "custom" approach to your molding requirements assures you maximum production per dollar of machine investment. With interchangeable machine units, you can select a machine to fit your requirements as if it were especially built for the job. This is possible because of the wide range of clamp tonnages, injection capacities, types of injection and injection speeds illustrated here.

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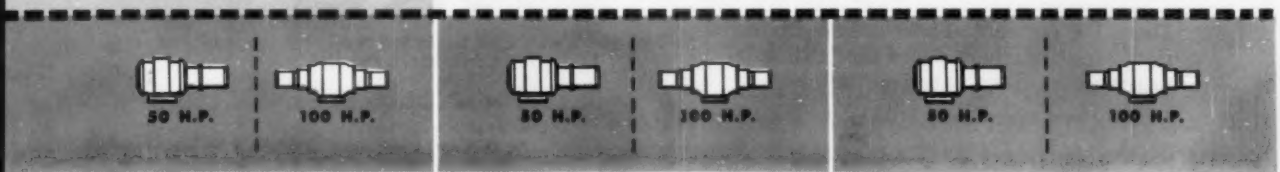

"NRC Vacuum Coater Cuts Production Time 75% Improves Schedules 100%"

. . . says James Kerr, Manager,
Electro-Vac Division of Radio Cores, Inc., Chicago, Illinois.

"Increased demand for our plating work required newer, more productive equipment. We investigated the vacuum coating equipment of several manufacturers and chose the NRC Equipment Corp. Model 3156.

"As for solving the problem of increased demand, the new NRC Vacuum Coater has more than quadrupled our output. Floor space is the same as the old equipment.

"Our plating cycle has been reduced 75 per cent. Humid weather no longer slows our production. The more efficient pumps and mechanically refrigerated cold trap on the NRC equipment have overcome the humidity problem.

"Delivery schedules have improved about 100 per cent. There are no production variations because of the NRC's dependability. Results are consistent.

"NRC installed the new coater and handled personnel training . . . only one week was needed to break in our own operator."

Electro-Vac has become a big contender in the growing finishing field . . . the company produces a quality product on modern equipment faster and at lower production costs. Interested in cutting your operating costs?

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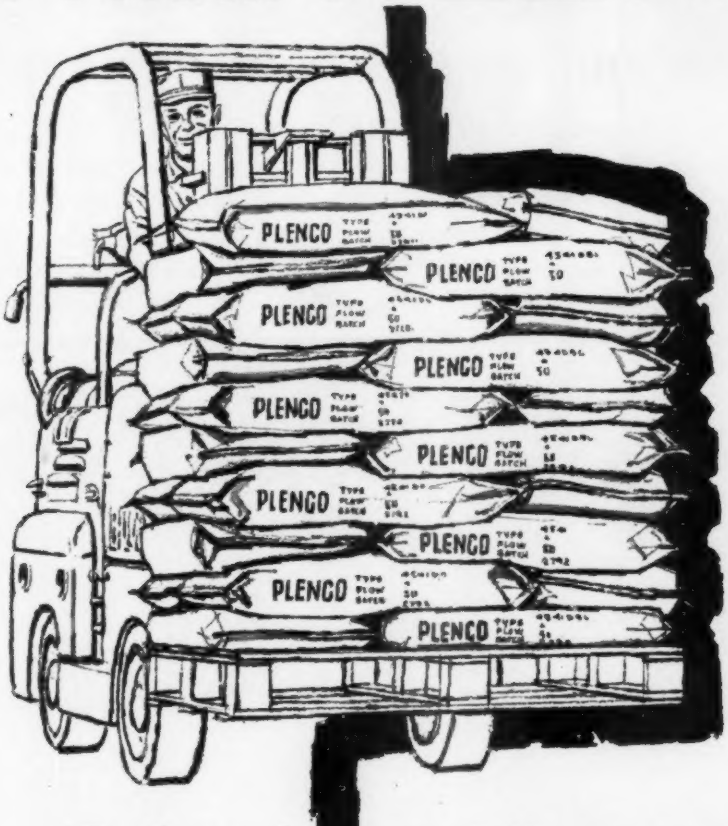

Palleted molding compounds for easier, low cost handling...

Do you know that PLENCO phenolic molding compounds are now available at no additional cost on expendable pallets? These pallets are 35" x 45" (holding 1500 lbs.), or 42" x 42" (holding 2000 lbs.), and you may specify the pallet size preferred by you.

Both are neat, uniform shipping units that can be safely stacked three high because all bags on each pallet are spot-bonded to each other, imparting unitized rigidity.

Palleted shipments reduce your direct labor handling cost. We have also added one other feature for easy inventory control and inventory status. We now stencil the material and batch numbers, color, flow, and customer's order number on the *sides* of the bag rather than the face. This makes identification easy and complete—with no need to climb on top of the load or remove a pallet to find out what's under it.

We don't expect a pat on the back for an idea as simple as this; but it does show that we are thinking in terms of your convenience when using PLENCO products.

a new convenience at no extra cost!

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FOR BETTER PLASTIC PRODUCTS

PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.

Foam plastic makes this boat unsinkable

The hull of this 11 ft. sailboat, designed to sell for under $100, is one solid piece of foam plastic—DYLITE® expandable polystyrene. Because of its tight cell structure and light weight, this amazing material has unmatched buoyancy. The boat stays afloat even if it's completely flooded. It can't become waterlogged because DYLITE doesn't absorb water. The hull weighs only 30 pounds, yet it can support over 500 pounds. Another Koppers plastic, DURETHENE® polyethylene film, is used in the durable yellow sail. Boat manufactured by Snark Products, Inc., Fort Lee, New Jersey.

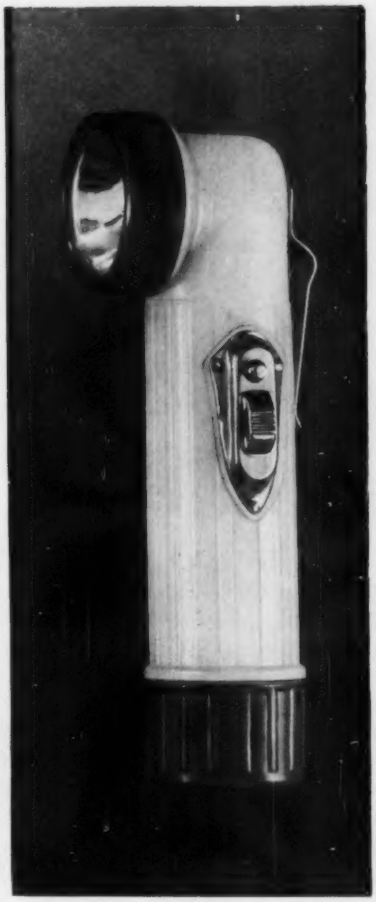
Cooler liner formed without thin spots

The interior liner of this Hamilton-Skotch picnic chest is thermo-formed from SUPER DYLAN® high-density polyethylene. This impact-resistant plastic is used because it's the only polyethylene that can be formed into this difficult deep-draw piece without producing thin spots or mold marks. The seamless liner won't leak, absorb food odors or water. Its smooth, white finish can't stain, discolor, rust or corrode—it's easy to keep clean. Bottles, cans and chunks of ice won't mar or crack its tough surface. Cooler Chest Manufactured by The Hamilton-Skotch Corporation, New York 16, New York.

Foam trays simplify toy packaging

A. C. Gilbert Company uses DYLITE expandable polystyrene trays because they completely eliminate costly interior packing materials. DYLITE trays are strong, good looking, easy to assemble and load—they save on labor costs. They also cut shipping costs because they're extremely lightweight.

DYLITE packages come in any size or shape; they fit firmly around the product and protect it from shipping damage. They make an attractive display because their smooth, colorful surface won't smear, chip or flake. DYLITE parts molded by Sullifoam Products, Willow Grove, Pennsylvania.



Flashlight guaranteed not to break

This new right-angle flashlight case is guaranteed unbreakable because it's molded from strong DYLAN® polyethylene. It's colorful, can't chip or flake. Unlike metal flashlights, it won't rust or corrode and it's completely acid-proof.

Koppers has a wide range of polyethylenes available for almost any application. They come in densities from .914 to .953 gm./ml. By varying density, molders or design engineers can get varying degrees of stiffness, heat distortion and tensile strength. Remember too, that polyethylenes can give you a wide range of colors. Flashlight manufactured by J. P. Gits Corp., Chicago, Illinois.

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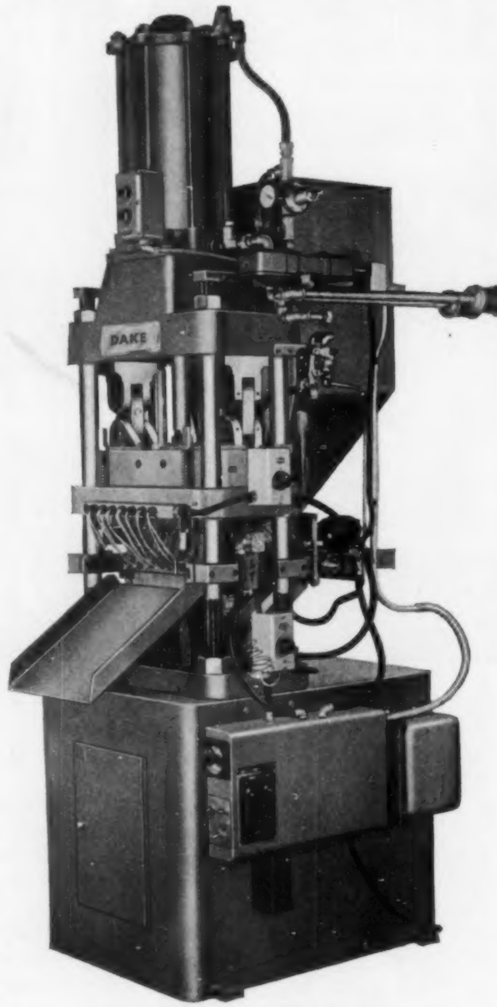
DAKE "49 SERIES"

LOWEST-PRICED HIGH-SPEED AUTOMATIC MOLDING PRESSES



Model 49-050
(50 tons capacity)

The new 49 Series of Dake presses is engineered for fast, dependable, economical molding of phenolic, urea, alkyd and epoxy compounds. You get more production with less maintenance *at lower cost!*

Take production, for example. Several users operate these presses on a fully automatic basis . . . 24 hours a day, 7 days a week. There are no rest periods, coffee breaks, washups or lunch times; so Dake's plastics molding presses deliver up to 14% more work than semi-automatics. In addition, they are the most reliable and have the fastest dry cycle speeds. Opening, unloading, filling and closing to the "slow close" point all take place in *less than four seconds.*

Maintenance costs are reduced, too, because of the simplified, air-operated toggle design. The feed tray is actuated by positive cams through the same mechanism, eliminating the need for additional feed cylinders and control valves.

And look at the savings. Your initial investment is lower than for other automatic presses of equal capacity. More important, one man can operate a battery of presses because a Dake plastics molding press requires only a fraction of a man's time to load the hopper and remove molded parts.

Dake's nationwide sales organization will be happy to acquaint you with these superior automatic molding presses, and serve you on the complete line of other Dake plastics presses.

Write today for a free copy of Dake's compression molding "Data Book". It discusses the economics of automatic thermoset molding, gives case histories, and explains many features and advantages of the Dake 49 Series.

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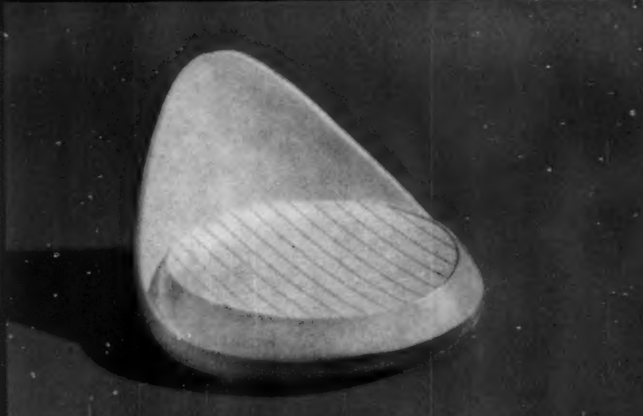


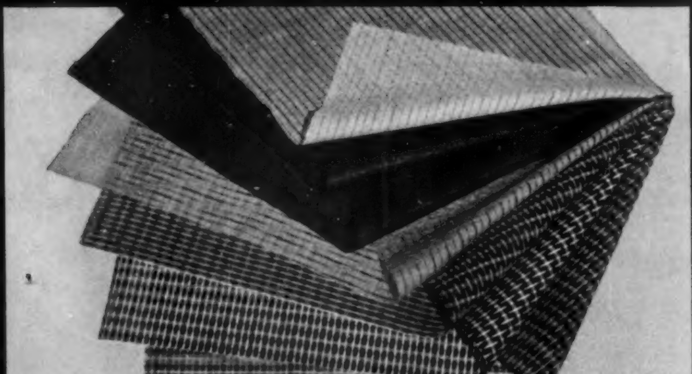
BAR SEAT (Kay-Mar, Cassopolis, Michigan, and Michigan-Par-elyte Molded Plastics, Dexter, Michigan)—This Contour Seat of MARLEX is attractive, durable, non-absorbent, and color-fast . . . moderately priced and offering long service life.

BABY SEAT (Infanseat Co., Inc., Eldora, Iowa)—Light, comfortable and durable. MARLEX is virtually indestructible, non-absorbent, non-allergenic . . . will never stain or lose color. Molded by Minnesota Plastics Corp., St. Paul, Minn.

More functional, colorful, and durable . . . because of MARLEX*

Today, furniture manufacturers are using MARLEX high density plastics to increase product performance and sales appeal . . . and keep manufacturing cost at a minimum. Components and parts of MARLEX are lightweight, tough, and virtually indestructible . . . resistant to acids, alkalies, greases, fungi, corrosion, heat and cold.

*MARLEX is a trademark for Phillips family of olefin polymers.



FILAMENT AND YARN FABRICS (Virginia Fibre, Petersburg, Va.)—Fabrics made with MARLEX filaments and yarns are color-fast, non-absorbent, dirt and stain resistant, long wearing.

CHAIR DESK (Virco Mfg., Los Angeles)—Handsome and functionally styled with tough, durable MARLEX seat and back that never need painting . . . has a long, maintenance-free life. Molded by Delkay Plastics Corp., Gardena, Calif.

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Now...closer temperature control of plastic fabricating equipment... with SARCOTROL high temperature cooling

AUTOMATICALLY HOLDS TEMPERATURES WITHIN ±1°F

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Utilizing the principle of High-Temperature-Cooling*, Sarcotrol achieves close-limit temperature control through a closed-circuit water circulating system employing high-velocity, high-capacity pumps and heat exchanger controlled by an exclusive, patented electrical temperature regulator. Completely flexible and versatile, Sarcotrol can be hooked up to any plastic fabricating equipment quickly and easily.

Sarcotrol is available in a wide range of sizes, capacities, and temperature ranges. Larger capacity models, models with separate free-standing control panels, air-operated models, and models operating on other than standard voltages are a few of the special Sarcotrol units that can be supplied on request. Our engineering staff is available for consultation on any special equipment.

*Conventional methods of cooling introduce cold water directly into the circulating system to remove excess Btu's. Overcooling at the inlet end of the circulating system and undercooling at the outlet end result in uneven temperatures across the plate or roll — and spoiled work. Sarcotrol's High-Temperature-Cooling method is basically the use of circulated water at only a few degrees lower than design temperature pumped at high rate, rather than the use of cold water, to cool. Because the difference between desired temperature and circulating water temperature is slight, the tendency to overcompensate is drastically reduced and cooling is uniform. Thus it is possible to maintain a much closer degree of thermal accuracy, and more even temperatures, throughout the plate, mold, or roll.

NEW BULLETIN AVAILABLE!

Full specifications and applications information on Sarcotrol are contained in Bulletin 1070. For your copy, contact your Sarcotrol sales office, distributor or write.

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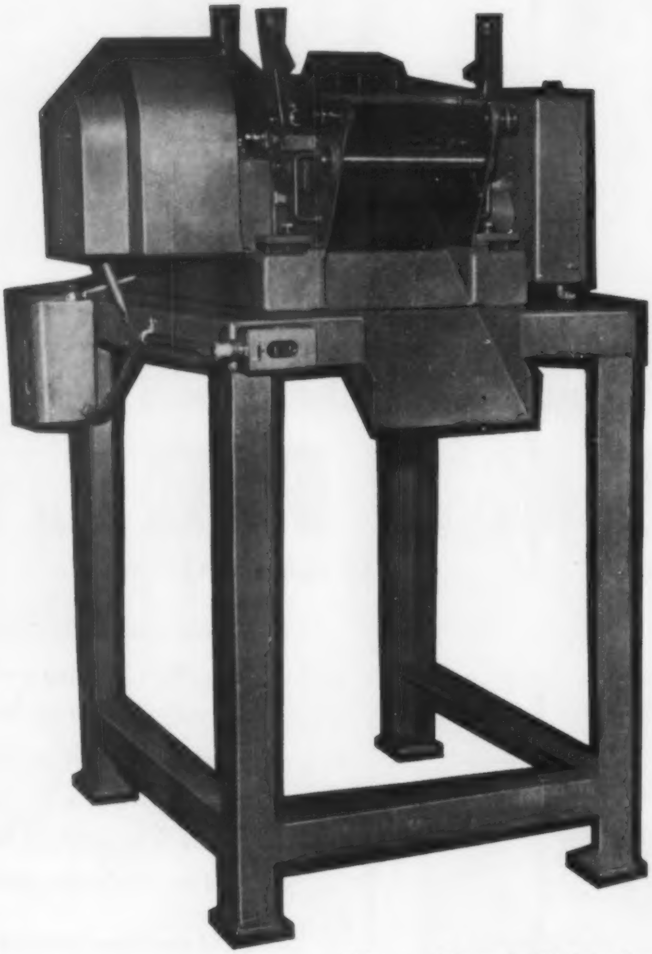
OF GRACE:
Merchandising Counsel

8 REASONS WHY PLASTICS MEN NOW REGARD

ALSTEELE PELLETIZERS

AS THE NEW STANDARD OF THE INDUSTRY



They handle all thermoplastic materials, even elastomerics.

They are highly compact, occupying a minimum of floor space. Power transmission is through a single belt.

A variable speed drive, which is an integral part of every machine, provides instantaneous synchronization with the extruder.

A new cutting angle design on the rotational knives eliminates tails on elastomerics, also holds fines to a minimum on rigid materials.

Feed roll advantages: They can be removed instantly in case of windup, or, for easy cleaning. They are as close as possible to the rotating knives to prevent strands from wandering. Both feed rolls are driven. Independent adjustable pressure can be applied to each end of the upper feed roll.

Flyback is held to a bare minimum because of the unique design of the cutting chamber.

Provision is made for the discharge of longs, independent of perfect pellets.

Provision is also made for an air- or water-cooling connection for the pellets.

For further details and prices on the machine more and more plastics compounders and virgin material manufacturers are ordering, write or call your nearest Alsteele representative today.

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48P-4 for up to 4½" Extruders
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*Available in mild or stainless steel

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Plastic users everywhere are discovering the MOVING IMPACT of Day-Glo colorants. Because they are fluorescent, they are inherently fresh, with color up to four times brighter! Most suitable for molded or extruded polyethylene and polyvinyl chloride resins, Day-Glo colorants are a natural for blow molded bottles, tubes, caps, toys, kitchenware and play balls. Their exceptional purity gives extraordinary stopping power at the point of sale.

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RESEARCH
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PLEGEN 4020

POLYETHER RIGID FOAM SYSTEM

The latest development in packaged urethane foam systems. Combines low cost, low viscosity, delayed foaming action, non-friability, low K-factor, high strength, excellent humid aging.

What more can you ask? You can't obtain the same combination of desirable properties in any other foam resin. PLEOGEN 4020 is a ready-to-foam two-part system for either batch or machine foaming (also available in spray formulation). Polyether foam made from PLEOGEN 4020 is now being used as a flotation agent in boats, as insulation in domestic and industrial refrigeration, in sandwich panels, and for general insulation in the construction industry. **For complete details, write today for Bulletin M-29.**

MOL-REZ DIVISION
American Petrochemical Corporation
3134 California St. N. E.
Minneapolis 18, Minnesota, U. S. A.

THE PLASTISCOPE*

How are we doing?

The U. S. Tariff Commission figures for plastics and resins are still a little too far behind current happenings to give a good idea of what the volume for plastics may be in 1961; but there are some interesting summaries in the latest returns, which are for April.

Take vinyl chloride as an example. First-quarter sales of resin in 1961 were 211 million lb., in contrast to 220 million for the first quarter of 1960. But March of 1961, at 77 million lb., was well over January and February 1961, and about even with March of 1960. April of 1961 was 1.5 million lb. under March 1961, but 4 million under April in 1960. However, April had two or three less working days than March and May. May of 1961 may be 10% more than March; while calendering resin sales were off, plastisols and rigids were apparently up. May of 1960 was well under that year's March figure.

Now take a look at polystyrene molding materials, exclusive of exports. First-quarter sales in 1961 were 149 million lb., compared with 138 million in 1960, with both January and March of 1961 well over the same months in 1960. May was expected to be as much as March, which is good news since it generally lags a bit behind. Increasing use in packaging is apparently keeping polystyrene sales well ahead of last year's totals, at least up to now.

In the meantime, Dow has announced a bulk price of 11¢/lb., F.O.B. plant, for rubber-grade monomer effective July 1 through Sept. 30. And Cosden has announced that its two new units for styrene monomer are now on stream, which will increase capacity from 20 million to more than 60 million pounds. D. M. Krausse, sr. vice president, stated that all of the new production has been committed or will be used for its own requirements to make polymer.

Polyethylene and polypropylene

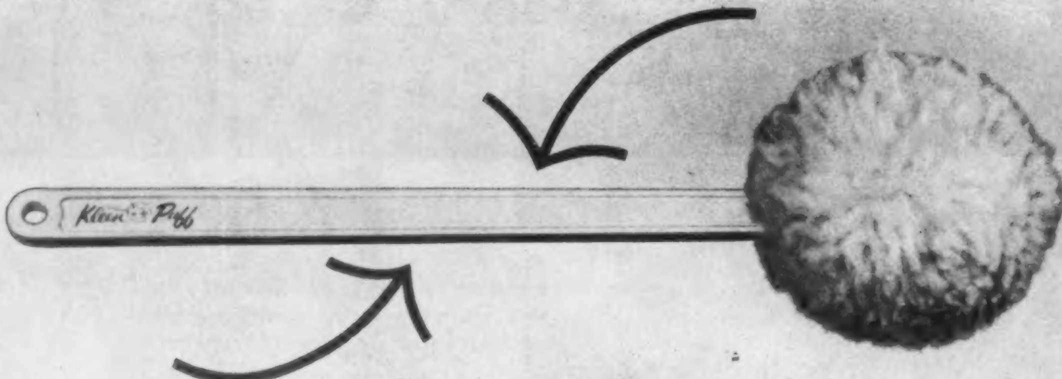
High-pressure (conventional) PE sales were running between 95 and 100 million lb. a month in the first quarter of 1961, a little under the 1960 first quarter, but total PE, including low-pressure high-density material, reached an all-time high in March of almost 120 million pounds. This was due to a big increase in high-density resin to about 23 million lb., whereas a year ago it was being sold at a rate of 12 to 14 million lb. a month. The increase is due primarily to blow and injection molding.

Polypropylene, listed separately for the first time in 1961, was moving at a rate of 4.8 million lb. in March. The March figures for all plastics indicated a good increase for practically all materials in 1961 over January and February of 1960, but it seems still too early to say whether this trend will continue for the rest of the year or whether the increase is only seasonal.

Price reduction for high-density PE

Announcement of lower prices for high-density polyethylene just before the Plastics Exposition in New York **(To page 41)**

*Reg. U.S. Pat. Off.



CMPC-molded mop handle has built-in germ fighter

Often, engineered plastics add important extra sales features to a product. A good example is the "Kleen-Puff"® mop, manufactured and sold internationally by the Zelinkoff Company of Wichita, Kansas.

CMPC injection molds the one-piece handle using a polypropylene-bacteriostat mixture. The bacteriostat, Biozel®, inhibits the growth of bacteria and odor-causing germs and resists mildew and mold . . . a big selling plus with housewives. Biozel is non-toxic and non-irritating to the skin. Tests indicate that its effectiveness continues for a year and longer.

Polypropylene was selected for the handle because of its strength, light weight and flexibility. These properties enabled CMPC to mold a small strap, used to fasten the mop attachment, as an integral part. Thus, the handle is strong and flexible—will bend around curves without breaking and it has no sharp edges to scratch surfaces being cleaned.

Perhaps these same advantages can be applied to your product. A call to your Chicago Molded Sales Engineer will bring you the services of an experienced and trained plastics specialist. Or write:

Send for new brochure "Design and Purchase of Custom Molded Plastics."

CMPC

CHICAGO MOLDED PRODUCTS CORPORATION
1020 H North Kolmar Avenue
Chicago 51, Illinois

resulted in quite a buzz among industry people when they all gathered together the following week.

The first report came from Hercules, which announced that the company's new 0.962-density resin would be priced at 32¢/lb., and that its older 0.945-density resin would be reduced from 38 to 35¢/pound. Previous prices for high-density polyethylene had been 35¢ for molding grade and 38¢ for blow-molded bottle grades. Specialty grade polyethylene resins went up to as high as 48¢ per pound.

W. R. Grace & Co. immediately followed the Hercules announcement with a reduction across the board. Their injection- and blow-molding grades, together with some extrusion grades requiring high stiffness and easy processability, are now 32 cents. Tougher grades requiring higher stress-crack and impact resistance and resins for extrusion-vacuum forming were reduced from 38 to 35¢/pound. Film-grade resins are now available at a new price of 33½¢, and a special high-strength film compound was reduced from 40 to 35 cents. Among the specialty compounds are flame-retardant high-density PE reduced from 48 to 43¢, and wire-and-cable materials reduced 3¢/pound.

Why the price drop?

At the rate high-density PE has been selling, a price drop was hardly expected, although it was generally conceded likely to happen any minute. While initial Tariff Commission figures for March were actually higher than real sales, because of a printing error, the corrected listing still shows a total of almost 23 million lb., or an annual rate of 276 million pounds. Total capacity is still difficult to estimate because of changing conditions, but is now thought to be in the area of 365 million pounds. Announced new capacity will bring that figure to 460 million by Jan. 1, 1962 and to almost 500 million by Jan. 1, 1963.

When Hercules announced its price reduction it also stated that capacity for low-pressure PE at the Parlin, N. J., plant had been raised from 30 million to 80 million lb. and that the purpose of the reduction in price was to broaden the market for blow molders putting them in better position to compete against other materials that are consumed by the bottle markets for bleach as well as other household chemicals.

Battle for the bottle

Activity in a variety of resins to meet the competition for various kinds of plastics bottles was discussed at some length in MODERN PLASTICS' report on the Packaging Show in the June issue. The high-molecular-weight and copolymer, or modified, high-density polyethylenes were developed primarily for two reasons: 1) to obviate environmental stress-cracking when the bottles were used for light-duty detergents, and 2) to make possible a thinner wall because of the material's inherent stiffness and thus save perhaps 20% in the cost of material that would be required in conventional PE to obtain equal stiffness.

But it was discovered that stress-cracking was no particular problem in bleaches, starches, and the larger-volume household detergents such as those used in washing machines, which are packaged in 2-qt. and 1-gal. sizes. Consequently, the resin producers got busy with new formulations. The new Hercules 0.962-density resin is one of them. **(To page 43)**

THE PLASTISCOPE

Polyethylene coated pipe

Among the many interesting applications shown at the recent N. Y. plastics show was Koppers' exhibit of its high-density PE material used for coating pipe made by Republic Steel Corp. Several million lb. of PE are now being used annually for this application, which has been more or less under wraps for a few years. Republic started commercial production of X-Tru-Coat on pipe in January 1958; a second line went into operation about 18 months later and a third line started in March 1961. Production has averaged over 1 million ft. per month. Three licensees are now also in operation.

The exterior extruded coating has a minimum thickness of 0.25 in., and pipe sizes range from ¾ in. to 8⅝ in. OD. The coating has a tensile strength of 3500 p.s.i. The coated pipe offers good resistance to corrosion caused by soil, water, and electrochemical action. Market estimators may wonder how much effect this development may have on the booming market for polyethylene tape used in wrapping underground pipe.

Another polyethylene copolymer

Spencer Chemical announced a new PE copolymer, named Poly-Eze, during the Plastics Exposition. It is reported to have properties related to low-density PE, plasticized vinyl, and rubber. It is elastic without requiring a plasticizer. It bears outward resemblance to low-density PE with improved flexibility, impact strength, and resistance to stress-crack. It is creating interest in the fields of blow-molded bellows, doll bodies, toys, and industrial applications that require chemical resistance and flexibility. Its impact properties are said by Spencer to be virtually unaffected by creasing.

Filling materials up to 90% can be used with Poly-Eze; used up to 50% they may not affect tensile or elongation properties. The resin has a density of 0.932 and a melt index of 2. Machine output generally exceeds that of PE of a similar melt index.

Spencer does not state what the other monomer is, but the trade assumes it is one of the acrylates. From the description of its properties, one could guess that it is similar to the new copolymers recently announced by Union Carbide and Dow, but different enough to avoid patent complications.

Other marketeers for polypropylene

Rexall has announced that it has begun resale of polypropylene. The supplier was not named but is generally believed to be AviSun. The trade name will be Elrex. Rexall had previously announced a joint venture with El Paso Natural Gas to build a 180 million lb./yr. plant for ethylene and propylene. Its new 120 million lb./yr. plant for low-density PE is scheduled to be completed in early 1962. No announcement concerning schedule time of high-density PE or PP plants has been made.

Another announcement that created a mild shock in the industry was news that Dow would furnish PP to Monsanto for developmental and experimental work. Thus, every producer but Tennessee-Eastman is now providing some other producer with polypropylene to develop markets or to resell. This is a highly interesting development and perhaps one way to lick temporary over-capacity. But scheduled production for polypropylene is still estimated at about 500 million lb. by January 1, 1965. **(To page 45)**

THE PLASTISCOPE

Permanently flexible phenolics

Koppers Co. has announced commercial availability of Flexiphen 160, a new phenol which will permit production of internally plasticized, permanently flexible phenolic resins. The new resins eliminate many undesirable properties that accompany inert, externally added plasticizers.

Some of the advantages are reduction of burning losses, lower s. g. which gives 5% more parts per lb. of molding compound, a 35% increase in Izod impact strength, and flow characteristics that give improvement in mold closing and transfer time.

Industrial laminates formed from these phenolics have good cold-punch properties with flexural strength nearly 30% higher than conventional phenolics—materials are particularly applicable to thin laminates in radio circuits. In decorative laminates the new resins give a high degree of post-formability. Impact strength and flexibility combined with phenolics' heat and corrosion resistance would improve insulating varnishes, brake linings, and grinding wheels. In fact, Koppers is enthusiastic enough about this material to state that it might compete with thermoplastics in such applications as TV cabinets, other housings, and circuit breaker covers.

Phenolic extrusions

Another interesting phenolic development is announcement of phenolic extrusions by York Industrial Plastics, York, Pa. The process comes from Europe. It is reported that extruded phenolic items have a fine surface finish with higher gloss than other materials. The extrusions are expected to find their major applications in market areas similar to those served by paper-based phenolic laminates. They are reported to have greater strength than laminates with flexural strength about ⅔ that of the reinforced material. The cost of phenolic extrusions varies from 50 to 75% that of equivalent items fabricated by laminating. Another suggested market is that now served by aluminum extrusions.

Lower-cost polypropylene film

AviSun Corp. has reduced the price of its Olefane PP film to 64¢/lb. in shipments of 500 lb. or more. It was formerly 70¢ in shipments of 10,000 pounds. At the same time the company introduced an 0.87-gage film which yields 35,400 sq. in./lb., with the resulting price, 1.81¢ per sq. in., putting it into competition with polyethylene film.

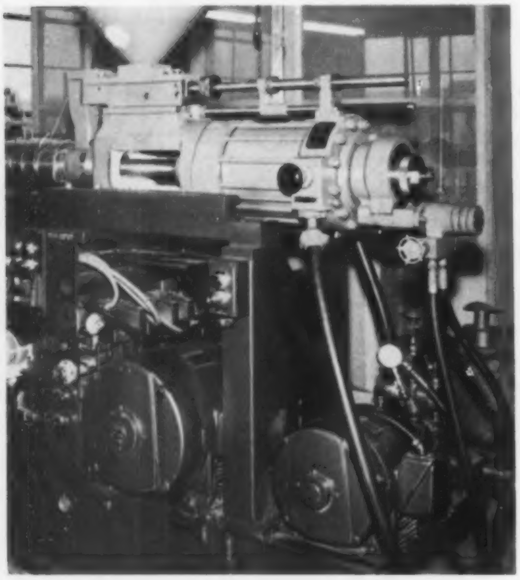
One-shot rigid foam

A new one-shot rigid, fire-retardant polyurethane, Hetrofoam 250, has been introduced by Durez Plastics Div., Hooker Chemical Corp. In field tests with sandwich panels, the foam reportedly has demonstrated rapid and uniform rise (1-ft./5 sec.) to heights exceeding 8 feet. The foam, made fire-retardant through the inclusion of chlorine-rich Het acid, is said to have good dimensional and heat stability, low water absorption, and moisture impermeability.

For additional and more detailed news see Section 2, starting on p. 184

NEW MACHINERY-EQUIPMENT

Specifications, claims made, and prices appearing in these pages are those of the manufacturers or sellers of the machinery and equipment described, or their agents.*



Rotating-spreader injection machines

Built under a license arrangement with the Du Pont Co., Fellows Model 3-125, 3-oz. injection machines are now offered with a rotating spreader which ups the injection capacity of the machine to 4 ounces. Shot volume is 6.1 cu. in. and plasticating capacity ranges from 30 to 60 lb./hr., depending on mold, product, and material. Operating rate ranges from 10 to 14 cycles per minute. Equivalent diameter of the bored injection plunger is 2 in. and the stroke is 8½ inches. Rate of injection is 6 cu. in./sec. and injection pressures up to 18,000 p.s.i. can be developed. The hydraulic motor which rotates the spreader is driven by an 11-gal./min. auxiliary pump. Heater unit power consumption is now 9 kw. (maximum). Other specifications are identical to the standard Model 3-125 machine. *The Fellows Gear Shaper Co., Springfield, Vt.*

Nozzle heater

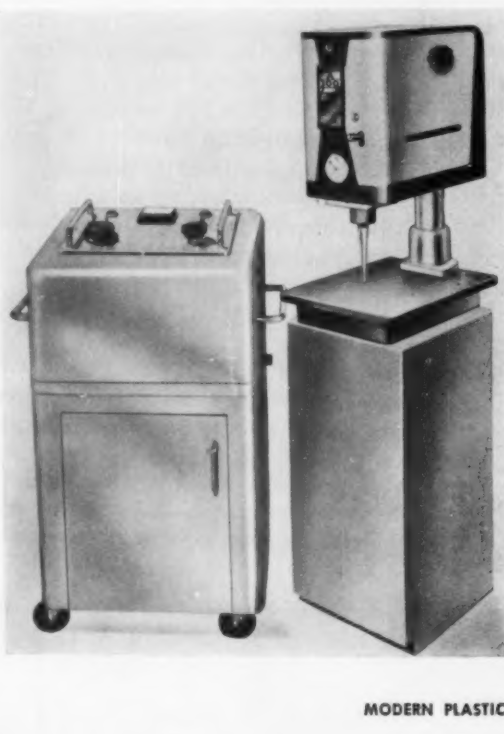
Starcast nozzle band heaters consist of tubular heaters in a one-piece split casting of Frontier 40E high-temperature aluminum alloy. All heater bands are 1½ in. wide with inside diameters from ¾ to 2½ inches. Outside diameters have been standardized at 2½ and 3½ inches. Terminal projections as short as ⅝ in. can be supplied. Nozzle bands may be ordered from stock in either 115- or 230-v. sizes. Anticipated life at the rated voltage is 400 hr. minimum. *Glenn Electric Heater Corp., 372 Jellif Ave., Newark, N. J.*

Extruders

Prodex Compact extruders have been designed to provide maximum output in the smallest amount of floor space and are available in 1¾- and 2-in. screw sizes for continuous heavy-duty operation at pressures up to 10,000 p.s.i. The smaller screw size is available as a 20:1 L/D unvented model or as a 24:1 L/D vented model. The 2-in. size is supplied with a 20:1 L/D ratio. Output rates of the 1¾-in. sizes at 2000 p.s.i. range from 40 to 90 lb./hr., depending on the material and application; outputs of the larger size range from 80 to 180 lb. per hour. Thrust bearings on both models are designed for a dynamic load of 65,500 lb., and maximum standard screw speeds range from 35 to 145 r.p.m., depending on hp. and application. Heater capacities are 7 kw. for the smaller unvented model; 10 kw. for the vented smaller model and the 2-in. model. Smaller models are powered by 5- and 7½-hp. motors, and the larger size by 10- and 15-hp. motors. Speed of the drives is continuously adjustable over a range of 4.5:1. Special valving is available. *Prodex Corp., Fords, N. J.*

Ultrasonic sealer

Designated the Zephyr "300", this machine will bond film and sheet made of polyester, polypropylene, and most other thermoplastics to identical materials or to other materials such as fabric and paper. Film and sheet up to 50 mils thick (100 mil total thickness of lapped film) can be sealed at linear rates up to 100 ft./min., depending on the type of film and thickness. Ultrasonic energy with a frequency of 20 kc. at 300 w. is used to effect the seal and is transmitted through a specially designed sealing tool. Sealing tools are interchangeable but must be tailored to the application and supplied by the manufacturer in most cases. The system consists of two separate units; a 25-kc. power generator and control console, and a head section carrying the air-cooled transducer, tool, and anvil. A dial gage on the head indicates the vertical travel of the transducer and head to within 0.5 mils. Since only a



* Prices are deemed to be F.O.B. sellers' plants (unless otherwise stated), are for "standard" models, and are subject to change without notice. The publishers and editors of **Modern Plastics** do not warrant and do not assume any responsibility whatsoever for the correctness of the same or otherwise.

"16 Van Dorn Presses

meet all our molding requirements . . . About 2½ years ago we ordered our first Van Dorns. Because they proved so dependable, we have repeatedly re-ordered and use Van Dorn machines exclusively."

says Mr. S. S. Berger, President
First American Natural Ferns Co.
Mount Vernon, New York

First American is a leading producer of polyethylene artificial flowers sold nationwide. To assist in their dynamic growth, they use only Van Dorn molding machines since their own experience has shown Van Dorns to be fast and economical. The presses are usually operated 24 hours per day, 6 days per week. They have all models—2½ oz., 3 oz., and 4 oz.—using a size best suited to each molding requirement.

You, too, can benefit with Van Dorn high-production injection presses. Write for detailed literature.

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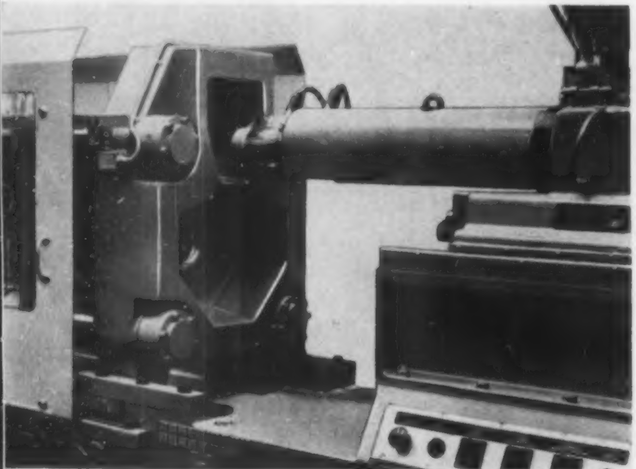
negligible amount of heat is generated, the tool may be stopped on the film without burning the material. In addition, the surfaces of the film need not be cleaned prior to sealing; in fact, seals may be made through oils and grease. Since the sealing tool is not electrically "hot," it may be touched during operation without danger. Price of a single unit is about $4250; a discount is allowed on larger orders. *Ultra Sonic Seal Inc., subs. of Kleer-Vu Industries Inc., 76 Madison Ave., New York 16, N. Y.*

Off-center injection machine

Ankerwerk reciprocating-screw injection machines can now be obtained with a special injection-end platen and an adaptor which allows the injection cylinder to be mounted in a way which permits filling of the mold from a point off the center. Available at extra cost, the new system



enables the machine to be used to its full potential. Advantages of linear, or off-center, filling are uniform mold fill, uniform mold shrinkage, and the production of stress-free moldings. The machines equipped with the special platen can also be converted to standard center filling in about 3 hr. by removing the special carriage, which is used for linear operation. *Ankerwerk International, 1229 E. Wakeham Ave., Santa Ana, Calif.*

Screw preplasticator

The De Mattia unit has a nominal shot capacity in polystyrene of 32 to 48 oz., and is suitable for mounting on most injection machines. Essentially a two-stage unit, in that a piggyback screw is used to plasticate the material and feed it to a secondary shooting chamber, the unit will plasticate up to 300 lb. per hour. The full injection stroke of 11¾ in. takes only 4 sec., and injection pressure on the material is variable to 23,000 p.s.i. A variable speed hydraulic drive is used to rotate the 3½-in. diameter screw. Total heater wattage provided for plastication is 29.45 kw.; four-zone heater control is provided. *Acme Machinery & Mfg. Co. Inc., 500 Saw Mill River Rd., Yonkers, N. Y.*

Heating-cylinder wire

Because of the difficulty of getting high-heat-resistant wire from ordinary supply houses, this glass fabric-insulated wire is especially made for wiring heaters in injection machines and extruders. It is available with both alloy and copper wire along with heat resistant tape and crimp on lugs. Wire is stocked for immediate delivery. *Injection Molders Supply Co. Inc., 17601 S. Miles Rd., Cleveland 28, Ohio.*

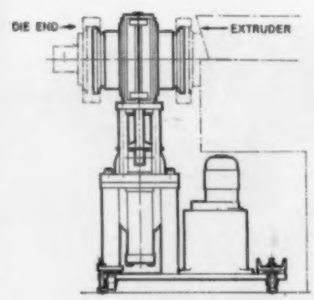
Heat treater

For molded vinyls and other plastics with a "memory," this unit has three major uses: 1) to reclaim mechanically deformed pieces, 2) to soften rigid parts for assembly, and 3) to act as a secondary curing oven. Using circulating hot air, parts are tumbled dry in the machine, eliminating the drying necessary with hot water treatments. The standard model uses gas heat; the special model is electrically heated. Basket holds up to 52 lb. of parts per cycle. Cycle and tumbling speed are controllable. A ½-hp. motor powers the unit. Standard model is priced at $525, f.o.b. factory. *Suffolk Associates, 107 E. 38th St., New York 16, N. Y.*

Draw-down indicator

Digital Draw Indicators count the number of rotations of each of two rolls and electronically compute the ratio of the relative roll speeds. The ratio is then digitally multiplied by a single constant to simultaneously adjust for the actual diameters of the rolls. The answer, or exact draw in percent, is then displayed directly in numbers. Accuracy is 0.1% at all speeds. The units are available in two types: Type A units have a maximum capacity to measure five draws or roll speeds; Type B units will handle as many as 50 measurements of draw or speed. *The Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis.*

Screen changer in three different sizes

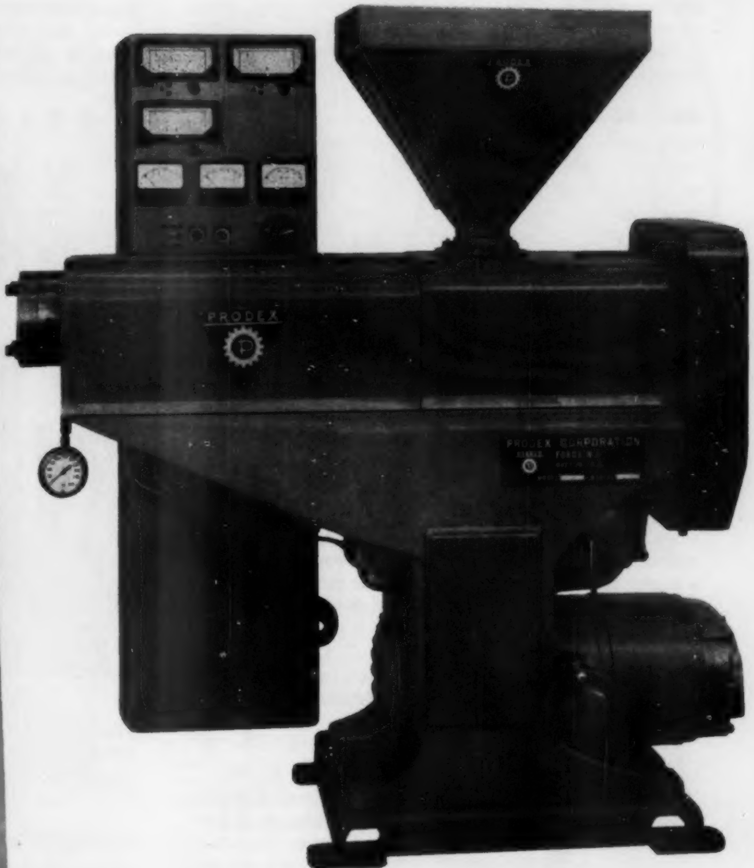


Available in three sizes to accommodate extruders of different size, the Hartig hydraulic screen-changer allows the extruder screen pack to be changed in seconds without removing the die or stopping the extruder, thus eliminating down time. Model SC-4.5 is designed for 2½-, 3½-, and 4½-in. extruders; SC-8 for 6- and 8-in. extruders; SC-10 for 8- and 10-in. extruders. The unit is mounted between the end of the extruder and the die, the die being mounted on the screen-changer. The body of the changer is covered with cast-in aluminum heaters to minimize heat loss. Screen packs are changed hydraulically and the pack is sealed when in the closed position to prevent leakage. Base of unit is equipped with casters and leveling bolts for adjustment and portability. *Waldron-Hartig Div., Midland-Ross Corp., P. O. Box 531, Westfield, N. J.*

Impact mill

Model 51000 centrifugal impact mill is made of stainless steel to minimize contamination and has been designed with about twice the energy capacity of earlier models. It is designed for the blending of pigments with plastic materials. Rotor speeds up to 5000 r.p.m. develop material velocities up to about 40,000 ft./min. and an impact energy up to 6800 ft.-lb./lb. of material being processed. Unit is sealed to allow use of inert gas blankets at pressures up to 100 p.s.i. Capacity varies inversely with the

REALLY COMPETE



OUTPUT RATES:
50—150 lbs/hr

L/D RATIOS:
20:1 and 24:1

the new

PRODEX COMPACT EXTRUDER

QUALITY FEATURES INCLUDE

- Heavy integral machine/motor base requiring half the space needed before.
- Alloy steel screw. Screw flights hard surfaced with Stellite (not flame hardened). They maintain their hardness, Rockwell C55, through highest extrusion temperatures.
- One-piece heavy wall cylinder Xaloy-lined.
- Thrust assembly with self-aligning spherical roller thrust bearing, large inspection window and circulating oil lubrication system.
- Large rectangular feed opening.
- Swing gate for easy die mounting.
- Automatic temperature control.
- Efficient air cooling.
- Full instrumentation, including screw speed indicator, melt temperature indicator and motor load ammeter.
- Continuously adjustable speed range 4.5 to 1.
- Completely prewired ready to run.

See the Prodex Compact perform with your own materials in our Customer Service Laboratory. Phone or write for an appointment or literature.

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square of the rotor speed and ranges up to several tons per hour. Depending on customer specifications, price of unit ranges between \$10,000 and \$20,000. Delivery is 10 to 20 weeks depending on the complexity of the unit. *Entoleter Inc., New Haven, Conn.*

Mold base revision

To allow for more flexibility in the inventory of raw steel and to improve service on DME mold bases, cavity retainer sets, mold plates, and other plate items, the length of all items in the standard 1518 Series will be revised from 18 to 17⅞ inches. This change will permit the use of the same standard sizes of mold steel used for the 17⅞-in.-wide series of products. The reduction in length of the 1518 Series will not affect any dimensions given from horizontal and vertical centerlines of the plan views shown on Page 58 of the DME catalog. Only dimensions affected are the over-all length and those dimensions which are measured from the ends of the base, which are now 1/16 in. shorter. *Detroit Mold Engineering Co., 6686 E. McNichols Rd., Detroit 12, Mich.*

Drying oven

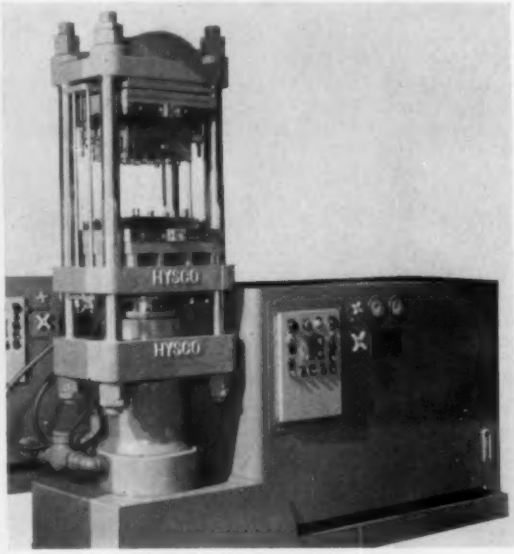
Designated Model RD-20, this air-circulating oven has a work space 40 in. square by 24 in. deep, with material shelves spaced 4 in. apart. It has two doors separated by a center post 3½ in. wide. Rate of air circulation is 655 cu. ft./min. at oven temperatures. Maximum oven working temperature is 400° F. An exhaust is provided for volatile gases. Insulation consists of a 3-in. fibrous glass blanket. *Ramco Equipment Corp., Div. of Randall Mfg. Co. Inc., Electric Oven Div., 801 Edgewater Rd., New York 59, N. Y.*

Injection press

The Auto - Hornet Mini-jector is a fully automatic machine capable of producing vinyl parts up to 1⅓ oz. in weight. It is hydraulically operated and has a clamp force of 18 tons. Maximum dry cycle rate is 500/hr. and the maximum casting area is 9 sq. inches. Standard equipment includes converging bore injection assembly with three pyrometer-controlled cylinder heaters. The rear plunger sleeve of this assembly can be interchanged with assemblies of 1 1/16, ⅞, ¾, and ⅝ in. so that injection pressure may be increased by reducing the bore size. Price of the press is \$3600. *Newbury Industries Inc., Newbury, Ohio.*

Transfer press

This Hysco press is designed to be adaptable for complete automation. The transfer ram is built inside the clamp ram; the circuit is designed to permit the transfer ram to automatically sequence after the clamp ram closes. The loading chamber is located at the bottom of the die, thereby facilitating loading and simplifying the entire operation. Adjustable rapid traverse is provided with automatic slow-down. Individual pressure regulation on the transfer ram is included. Platens are electrically heated with individual thermostatic controls. Press can be sup-



plied with manual, semi-automatic, or automatic controls. Units are available in capacities from 40 to 170 tons. *Hydraulic Supply Co. Inc., 10801 S. Sessler St., South Gate, Calif.*

Hydraulic apron

An hydraulic apron adjustment and knife pressure indicating gage are now standard on the manufacturer's line of three roll mills. The apron adjustment enables apron and knife to be set to a given pressure against the front roll or released for cleaning. Knife pressure is maintained constant even as the knife wears; positive control of the pressure assures a more thorough removal of material from the front roll and is said to increase production by 10 to 20 percent. Use of razor knives at controlled pressure has also reduced scoring of the rolls. *Charles Ross & Son Co., 148-156 Classon Ave., Brooklyn 5, N. Y.*

Radiant heaters

Panel heater uses a specially prepared quartz panel which acts as a radiant heat diffuser. The radiant heat is generated by means of resistance-type heaters mounted on the back side of the panel. Because of the properties of the quartz, the radiant heat is evenly distributed over the panel, eliminating hot spots. Suitable for use in vacuum-forming machines and other plastic sheet-heating operations, the panels are supplied in two standard sizes, 12 in. square or 12 by 24 inches. However, almost any size panel can be supplied on special order. Heater density and operating temperature are dependent on the wattage selected. *Hugo N. Cahnman, Electrical Engineer, 98-40 64th Ave., Forest Hills 74, N. Y.*

Blow molder

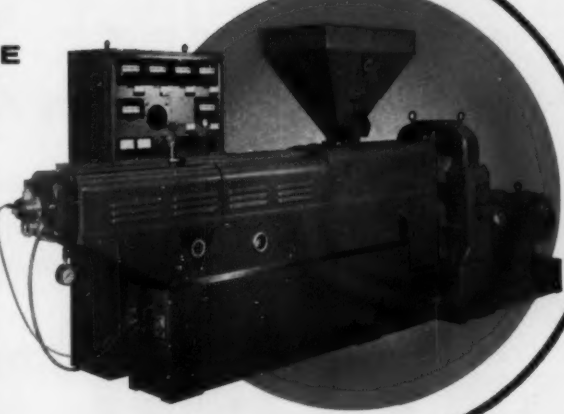
Model V-21 OHP Diversamatic blow-molding machine is equipped with piston-type accumulators which act as material reservoirs and provide for rapid, high-pressure parison

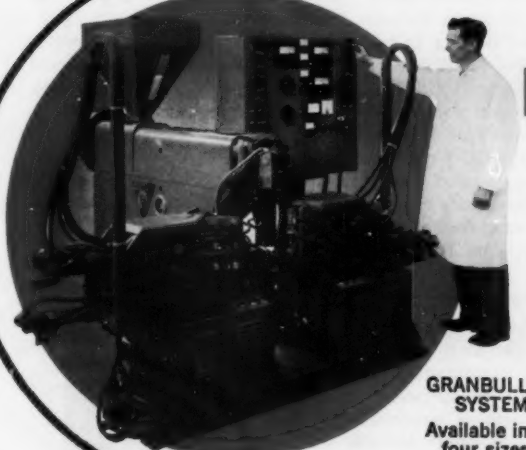
Years Ahead!

PRODEX HIGH TORQUE EXTRUDERS with CHANGE GEARS

now permit you to select quickly the optimum reduction ratio and screw speed necessary to extrude **either high or low viscosity materials** at maximum horsepower efficiency and highest possible production rate for each extrusion job.

Prodex extruders give you the best possible machine return on your investment of any extruders in the world today. These machines are built vented or non-vented in a complete range from 1¾" to 10".





GRANBULL SYSTEM
Available in four sizes

PRODEX FULLY AUTOMATIC BLOW MOLDERS

For small parts—up to 2 gal.—a toggle clamp mechanism is used to develop high pressures and high speed action. A continuous parison flow from a single head feeds up to four mold clamps, resulting in extreme uniformity of parts. The highly streamlined head permits use with all polymers, including rigid PVC.

For large parts—5 to 55 gal.—an accumulator system allows fast extrusion of large parisons, with precise shot metering and uniform temperature throughout the parison prior to blowing.

Prodex blow molders, for maximum output and reliability of operation, are supplied with specially designed, high-performance **Prodex extruders.**

THE REVOLUTIONARY

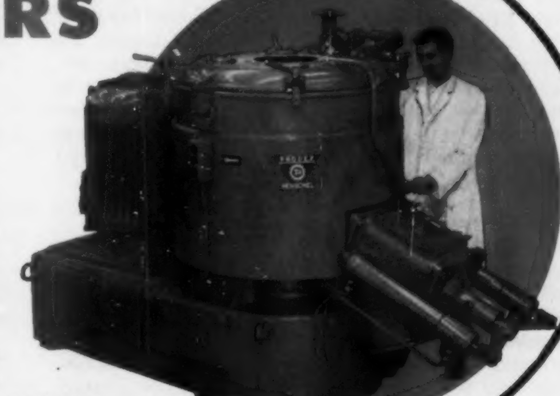
PRODEX MIXERS

(HENSCHEL SYSTEM) U. S. Pat. No. 2,945,634

FOR INTENSIVE

Resin Dryblending • Pigment Dispersion • Mechanical Heating • Vacuum Drying of resins and compounds in EXTREMELY SHORT CYCLES WITH EXCELLENT UNIFORMITY!

Both laboratory and high production units are now available with capacities from a few lbs. to thousands of lbs./hr. • They can be cleaned quickly and easily. • All contacting surfaces are stainless steel. • Vacuum tight construction is available for vacuum extraction. • Loads and discharges while running.



Available in four sizes

See PRODEX extruders, blow molders and mixers perform with your own materials in our customer service laboratory. Write or call for an appointment.

PRODEX
—in design and performance
ALWAYS A YEAR AHEAD

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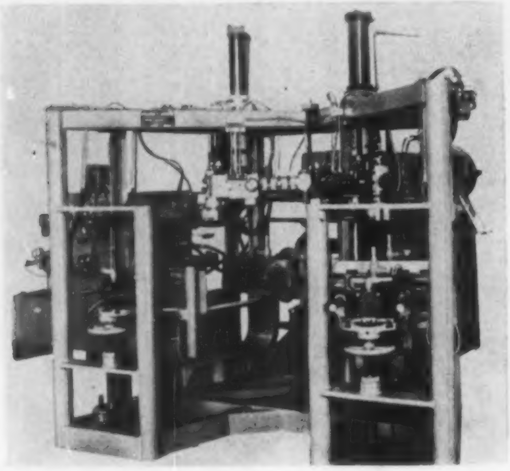
 (From page 50)

extrusion. Mounted between the extrusion head and the die station, one accumulator is filled on the mold cooling cycle while others are discharging parisons to the mold. Each accumulator is Xaloy-306 lined and has an 8-ton



plunger force. Accumulator capacies range from 30 to 150 cu. inch. The manifold design allows removal of the breaker plate and extruder screw at the front of the machine without disconnecting the unit from the extruder. Units are available with two, four, or eight blowing heads. With four heads (two per station) the machine will produce 700 1-qt. bottles per hr.; with four heads per station it will make 1400 per hour. Used with a $3\frac{1}{2}$-in. extruder, the production capacity is 250 lb. per hour. *Modern Plastic Machinery Corp., 64 Lakeview Ave., Clifton, N. J.*

Heating tapes

Thermobande is an electrical resistance-type heating tape with adhesive paper backing which can be used for welding and bending of thermoplastic sheets and films. This metal alloy tape may be stuck to any surface. The tapes are available in 25 different dimensions and two types: Type SF (single face) and Type DF (double face). SF tape is used for bending and welding thin materials; the DF tape is used in combination with SF tape when handling sheet $\frac{1}{8}$ in. and over. Each 50-ft. roll of tape is supplied with data on dimensions, type, and maximum amperages which may be handled. The tapes may be reused several times. *Laramy Products Co., Beechwood St. at Rt. 3A, Cohasset, Mass.*

Injection machine

The Netstal Neomat 110/565 is a reciprocating-screw injection machine which is available with screws of three different sizes to suit specific needs. Screw sizes are $1\frac{17}{64}$, $1\frac{15}{32}$, and $1\frac{49}{64}$ in.; screw speeds are steplessly adjustable from 0 to 94 r.p.m. Injection pressures and shot volumes in the order of sizes above are 16,000, 11,600, and 8000 p.s.i., and, 3.42, 4.7, and 6.71 cu. in., respectively. Plasticating capacity, depending on the screw size and material, ranges from 18 to 40 lb./hr., while shot weight ranges from 1.73 to 4.0 ounces. Clamping is by hydraulic-mechanical toggle system; maximum clamp force is 60 tons. Distance between two tie rods is $10\frac{5}{8}$ in.; platen height is $11\frac{13}{16}$ inches. Maximum daylight is $11\frac{11}{32}$ inches. Typical production rate is 1200 shots per hour. *Husky Mfg. & Tool Works (Ontario) Ltd., 200 Bentworth Ave., Toronto 19, Canada, or Husky of America Inc., 5 State Rd., Lockport, N. Y.*

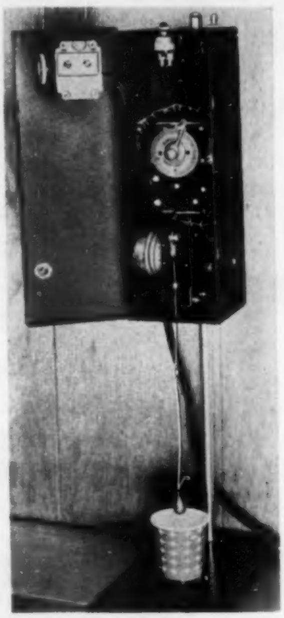
Proportional controller

The Thermo Electronic controller provides accurate proportional off-on process control with almost no cycling, and will not permit process conditions to exceed pre-set limits. Used in conjunction with primary instruments, such as indicators or recorders having transmitting slidewires, this unit will control pressure, temperature, or other process parameter. Accuracy is $\frac{1}{4}$% of controller span as referred to accuracy of the primary instrument. *Thermo Electic Co. Inc., Saddle Brook, N. J.*

Injection machine

The Automolder Model KS6-100-50 is a reciprocating screw unit with a 6-oz. shot capacity and a 60 lb./hr. plasticating capacity. It has a $1\frac{3}{4}$ in. screw with an effective L/D ratio of 16 and an injection stroke of 4 in., which will deliver about 6.5 cu. in./sec. at pressures up to 27,500 p.s.i. on the material. Maximum screw speed is 450 r.p.m., and heating cylinder power consumption is 6 kilowatts. Upper limit of clamp force is 100 tons. Minimum mold thickness is 9 in., and maximum daylight is 18 inches. Longest clamp stroke is 9 in., and molds up to 12 by 15 in. across can be handled; nominal casting area is 100 sq. inches. Dry cycling rate is 1500 cycles/hr., and the machine may be run manually, semi-automatic, or automatic. Optional extra equipment includes low-pressure closing, heat control for hot runner molds, and extra accumulator bottle. *Standard Tool Co., Leominster, Mass.*

Gel timer

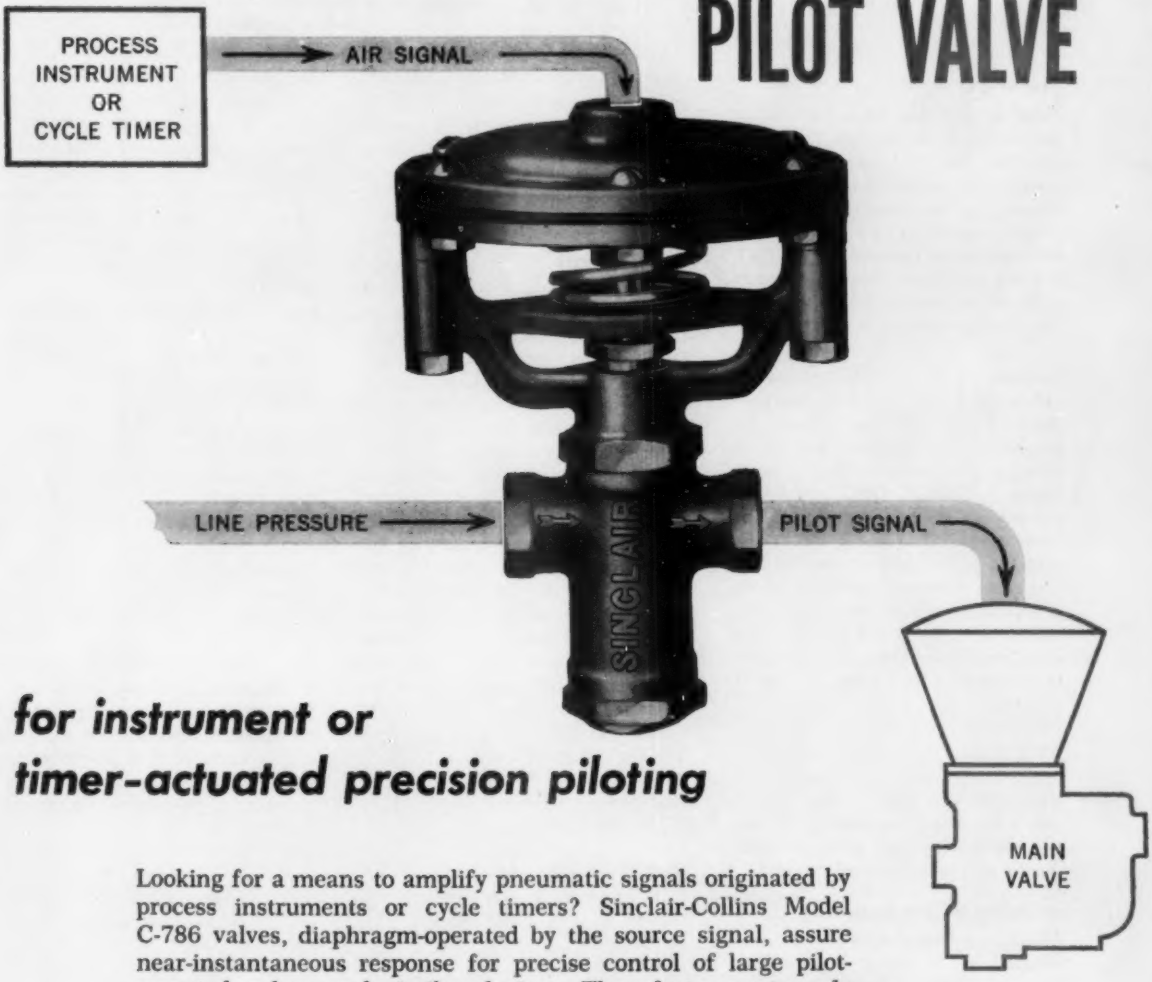


The Mol-Rez timer measures the gel point of thermosetting resins. In operation, a weight is continually raised and lowered into a container of resin under test. When gelation takes place the weight is arrested in its travel by the solidifying resin and an electrical circuit records the time at which gelation took place. Disposable sample containers and weights eliminate the need for clean-up. Price is $97 f.o.b. mfr. *Mol-Rez Div., American Petrochemical Corp., 3134 California St., N. E., Minneapolis 18, Minn.*

Ultrasonic sealer

For the sealing of Mylar, polyethylene, and other thermoplastic film, the Model 350 ultrasonic sealer delivers over 25,000 sound wave pulses per minute. Power rating of the unit is 300 w. at 60 c.p.s. The unit is equipped with the manufacturer's 26 Kc. generator, transducer coolant is 600°F. transformer oil, force-fed by pump. Hammer acts against a rotating anvil made of hardened tungsten steel. Depth penetration control includes **(To page 148)**

Compact, low-cost SINCLAIR-COLLINS PILOT VALVE



for instrument or timer-actuated precision piloting

Looking for a means to amplify pneumatic signals originated by process instruments or cycle timers? Sinclair-Collins Model C-786 valves, diaphragm-operated by the source signal, assure near-instantaneous response for precise control of large pilot-operated valves and similar devices. They feature extremely short stem travel, from closed to fully open, and a flow area equal to ¼ in. standard pipe.

Space a problem? The Model C-786 measures but 5⅜ in. high . . . is only 3⅞ in. in diameter. Cost a problem? You'll find this valve, with all the built-in quality features found in every S-C valve, priced attractively.

Models for air, steam, hot or cold water, or inert gas service; bronze, ductile iron or stainless steel bodies; 2 or 3-way; 20 to 50 psi signal, 125 psi main valve; tapped ¼ in. NPT. Ask your nearby Sinclair-Collins Field Engineer to show you how the Model C-786 fits your instrumentation control system.

The SINCLAIR-COLLINS VALVE Co.
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)
AKRON 11, OHIO

For more information, write for Bulletin 59-SC. Address The Sinclair-Collins Valve Company, Akron 11, Ohio, Dept. MP-761.

8189

WORLD-WIDE PLASTICS DIGEST*

Abstracts from the world's literature relative to plastics. For complete articles, send requests direct to publishers. List of addresses is at end of this section.

Materials

Extrusion of sheet from high-density polyolefins. R. Doyle. SPE J. *17*, 165-69 (Feb. 1961). A summary is presented on methods of equipping, starting up, and running a sheet extrusion operation for high-density polyolefins. An operating guide chart is given to indicate solutions to some of the more common difficulties occurring during operation.

Synthesis and properties of methyl methacrylate - dimethacrylamidodimethyl ether copolymers. I. A. Arbuzova, V. N. Efremova, and A. G. Eliseeva. Vysokomolekuliarnye Soedineniia *2*, 1828-31 (Dec. 1960). Copolymers of methyl methacrylate and dimethacrylamidodimethyl ether were prepared and their properties studied. The ether causes a crosslinking, giving a maximum strength when the ether content is about 5-mol percent. The glassy transition temperature continues to rise with increased mol percent of the ether.

UV absorbents as synthetic resin stabilizers. H. Gysling and H. J. Heller. Kunststoffe *51*, 13-17 (Jan. 1961). The various commercial ultra-violet light stabilizers and problems concerned with their use are reviewed.

Molding and fabricating

Extrusion of elastomers and thermoplastics. W. S. Penn. Plastics Inst. Trans. *28*, 254-56 (Dec. 1960). A brief review of extrusion and extrusion techniques is given.

An optical method for measuring uniformity in plastics. R. M. Eichhorn. Ind. Eng. Chem. *53*, 67-70 (Jan. 1961). A method for making reproducible measurements of uniformity of mixtures was developed for mixing operations. For transparent and translucent materials, the standard deviation of optical absorbance provides a numerical index for the degree of mixing accomplished. The variation in absorbance is obtained by scanning a thin sample with a microdensitometer. When the transmitted light, sensed by a phototube, is fed to an analog computer as a varying voltage signal, the standard deviation is automatically computed and indicated. By continuous scanning, this method assesses the absorbance of many small samples and thereby provides a standard deviation value which is reproducible and reliable. Automatic computation of the standard deviation value reduces analysis time and makes the method simple enough for routine use.

Applications

Evaluation of plastic films for protective suiting. A. E. Symonds Jr. U. S. Atomic Energy Comm. Report DP-528, Nov. 1960. 18 pp. A laminate of saran and polyvinyl chloride film is the best of several films tested for use in suiting for protection of personnel in atmospheres containing tritium. Candidate films were evaluated by measuring the permeability to and diffusion rates of tritiated water vapor, and by measuring the retention and ease of removal of tritium activity. An improved cell for measuring the permeability of polymer films was developed as a means of evaluating the films. The cell utilizes the ionizing properties of the radiation from tritium to detect the concentration of tritiated water vapor diffusing through the test films. Available from the Office of Technical Services, Washington 25, D. C. at 50¢ per copy.

High-density polyethylene containers. B. B. Heise, J. H. Parliman, and J. Pinsky. Modern Packaging *34*, 112-18, 167 (Jan. 1961). A comprehensive analysis of the factors involved in package evaluation is presented. Among the factors considered are permeability, leakage, side-wall distortion, stiffness, and machine handling. Various test methods used in the analysis are described.

Properties

Relationship of surface defects to surface failures in reinforced plastics. W. J. Diamond. Plastics Tech. *7*, 29-31 (Jan. 1961). Specimens of fibrous glass-reinforced plastics were examined by microscopic methods before and after being subjected to stress. The application of stress propagates defects in the specimen but probably does not create defects.

Testing

Determination of the relative isotactic content of polypropylene by extraction. C. A. Russell. J. Appl. Polymer Sci. *4*, 219-24 (Sept.-Oct. 1960). The variables affecting the extraction of polypropylene are considered. Under controlled conditions, the extraction of polypropylene with first diethyl ether and then *n*-heptane will give reproducible results. It is necessary to extract with heptane in an atmosphere of nitrogen. The values obtained by the extraction procedure described are regarded as relative measures of the amounts of isotactic, stereoblock, and atactic material present in a sample. Extraction with *n*-heptane alone by this procedure also gives the same value of relative isotacticity. Infra-red studies showed that the ether soluble fractions were essentially atactic, while the *n*-heptane-soluble or stereoblock material possessed a degree of order corresponding to 20 to 40% isotactic polypropylene.

Evaluation of micrometer and microscopical methods for measuring thickness of floor coverings. E. Horowitz, J. Mandel, R. J. Capott, and T. H. Boone. Materials Research & Standards *1*, 99-102 (Feb. 1961). The dial micrometer and microscopical (optical) methods for measuring the thickness of floor coverings were evaluated in an interlaboratory study for four samples having wearing layer thickness in the range 5.5 to 22 mils. With experienced personnel, there is no significant difference in the results obtained by the two methods; the grand averages agree to within 0.04 mils. Using four replicate measurements the standard deviations for the micrometer and optical methods are 1.15 and 1.19 mils, respectively. The measurement of thickness does not appear to be affected by pressure feet of different diameters between the limits of 0.10 and 0.25 in. when the load of the pressure foot is maintained at a p.s.i. rating between 18.6 and 22.4.

Publishers' addresses

Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Journal of Applied Polymer Science: Interscience Publishers Inc., 250 Fifth Ave., New York 1, N. Y.

Kunststoffe: Karl Hanser Verlag, Leonard-Eck-Str. 7, Munich 27, Germany.

Materials Research and Standards: American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

Modern Packaging: Modern Packaging Corp., 770 Lexington Ave., New York 21, N. Y.

Plastics Institute Transactions and Journal: The Plastics Institute, 6 Mandeville Pl., London, W1, England.

Plastics Technology: Bill Brothers Publishing Corp., 630 Third Ave., New York 17, N. Y.

SPE Journal: Society of Plastics Engineers Inc., 65 Prospect St., Stamford, Conn.

Vysokomolekuliarnye Soedineniia: Academy of Science of U.S.S.R., Moscow, Russia.—End

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4 more builders get excellent results with Polylite *polyester resins*

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- **batch-to-batch uniformity** gives positive assurance of consistent curing characteristics.
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- **POLYLITE hulls are exceptionally sturdy:** better able to withstand impact, resist cracking; are safer; last longer.
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If you are looking for products to help you build better boats more profitably ask about RCI POLYLITE. For the address of your nearest source of supply, write to Reichhold Chemicals, Inc., RCI Building, White Plains, N. Y.

Upper Left: 16' DEL MAR — Glasspar Co., Santa Ana, Calif.
Upper Right: 14' 5" MACKINAC — Wagemaker Boat Company, Cadillac, Mich.
Lower Left: 17' ESCAPADE — Shell Lake Boat Company, Shell Lake, Wisc.
Lower Right: ARISTOCRAFT FUNLINER "17" — Atlanta Boat Works, Atlanta, Ga.

REICHHOLD

U.S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.

U. S. Pats., Mar. 14, 1961

Polyvinylidene cyanide. K. L. Sayre (to B. F. Goodrich). 2,975,158.

Ethylene-olefin interpolymers. V. Weinmayr (to Du Pont). 2,975,159.

Copolymers of fluorinated ethers. J. G. Abramo and R. H. Reinhard (to Monsanto). 2,975,161.

Polyvinyl chloride. A. Iloff (to VEB). 2,975,162.

Interpolymers of fluorine-containing monomers. E. S. Lo (to 3M). 2,975,163-4-5.

U.S. Pats., Mar. 21, 1961

Bonding to polyurethanes. S. Salem and D. W. Anderson (to General Tire). 2,976,202.

Cellulose ester sheets. C. D. Snead and R. W. Peters (to Eastman Kodak). 2,976,205.

Butadiene-furfural compositions. M. T. Harvey and P. L. Rosamilia (to Harvel). 2,976,264.

Epoxide compositions. J. W. Pearce (to S. C. Johnson). 2,976,265.

Film-forming polyesters. M. R. Lytton and E. A. Wielicki (to American Viscose). 2,976,266.

Polyesters. J. R. Caldwell and J. C. Martin (to Eastman Kodak). 2,976,-267.

Polymer of 2,6-disubstituted heptadiene-1,6. G. N. Milford Jr. and F. T. Wall (to Du Pont). 2,976,268.

Ethylene–sulfur dioxide polymers. J. L. deJong (to Du Pont). 2,976,269.

U.S. Pats., Mar. 28, 1961

Reinforced tanks. C. M. Nerwick (to Structural Fibers). 2,977,268-9.

Optical brightening of polymers. F. Ackermann and A. E. Siegrist (to Ciba). 2,977,319.

Ion exchange beads. L. A. Mattano and M. J. Hatch (to Dow). 2,977,328.

Cellular polyurethanes. F. M. Brower (to Dow). 2,977,330.

Epoxy-polyamide compositions. H. Zumstein (to Ciba). 2,977,332.

Ethylene-maleic anhydride copolymers. G. W. Zopf Jr., J. H. Johnson, R. M. Hedrick, J. E. Fields, and J. M. Butler (to Monsanto). 2,977,334.

Vinylidene chloride copolymer. C. B. Havens (to Dow). 2,977,335.

Cyanoethylated polyacrylonitrile. W. H. Schuller (to American Cyanamid). 2,977,337.

Copolyoxamides. C. R. Lindegren (to Du Pont). 2,977,339.

Polyoxamides. S. D. Bruck (to Du Pont). 2,977,340.

Vinyl pyridinium betaine polymers. W. H. Schuller and J. A. Price (to American Cyanamid). 2,977,341.

Linear polyamides. H. J. Twitchett and A. S. Wild (to Imperial Chemical). 2,977,342.

Isoolefin-multiolefin copolymers. R. L. Zapp and M. W. Swaney (to Esso). 2,977,343-4-5-6-7-50.

U.S. Pats., Apr. 4, 1961

Gamma-ray polymerization. W. C. Hollyday Jr., J. F. Black, J. F. Shewmaker, and J. F. Nelson (to Esso). 2,978,395-6.

Permselective membranes. P. E. Hoch and P. Robitschek (to Hooker). 2,978,401-2.

Copolymers of phosphorus sulfides and unsaturated esters. D. A. Guthrie and C. L. Knapp Jr. (to Esso). 2,978,412.

Nitrile copolymers. J. A. Holloway (to B. F. Goodrich). 2,978,421.

Potting compositions. W. M. Hutchinson and C. A. Chanek (to Phillips). 2,978,429.

Polypropylene. W. E. Thompson and D. R. Mullin (to Sun). 2,978,430.

Polyethylene composition. J. D. Engle (to Union Carbide). 2,978,431.

Polymers of methylol-ether-containing compounds. W. Graulich and K. E. Müller (to Bayer). 2,978,432.

Acrylic-aminoplast compositions. M. D. Hurwitz (to Rohm and Haas) 2,978,433.

Polyester molding composition. A. M. Howald (to Glaskyd). 2,978,434.

Epoxy-dicarboxylic anhydride composition. O. Ernst (to Ciba.) 2,978,435.

Cyclic polymer. J. F. Jones (to Goodrich). 2,978,436.

Acrylamide-aldehyde interpolymers. R. M. Christenson (to Pittsburgh Plate Glass). 2,978,437.

Polyamides. H. Indest, J. Kleine, and H. Stöhr (to Vereinigte Glanzstoff Fabriken). 2,978,438.

Polyamides. A. Kersting (to Bayer). 2,978,439.

Antistatic vinyl chloride copolymer. W. J. Frissell Jr. and V. J. Honska (to Union Carbide). 2,978,440.

Polyolefins. F. T. Sherk (to Phillips). 2,978,441.

Polyethylene. E. N. Brightbill and K. P. Lindland (to Du Pont). 2,978,442.

Polypeptides. R. Schwyzer, B. Iselin, H. Kappeler, W. Rittel, and B. Riniker (to Ciba). 2,978,444.

U.S. Pats., Apr. 11, 1961

Alkyd resins. R. L. Heinrich, D. A. Berry, and Richard Dick (to Esso). 2,979,472-3-4.

Potting composition. R. L. Hudson (to U. S.). 2,979,475.

Blending polystyrene and wax. R. B. Bishop and J. S. Pavlin (to Foster Grant). 2,979,476.

Polyvinylpyridine-hydantoin formaldehyde composition. E. H. Land (to Polaroid). 2,979,477.

Polyvinyl alcohol-phosphoric ester composition. T. M. Melton, R. A. Matthews, and H. F. O'Connor (to Virginia-Carolina). 2,979,478.

Vinyl chloride resins. R. A. Piloui and G. P. Rowland Jr. (to Firestone). 2,979,480.

Organopolysiloxanes. W. A. Piccoli (to Dow Corning). 2,979,482.

Linear polyesters. E. J. Kowolik and J. Lincoln (to British Celanese). 2,979,483.

Phenolic resins. C. A. Redfarn (to Walker Extract). 2,979,484.

Trimerizing isocyanates. J. Burkus (to U. S. Rubber). 2,979,485.

Linear polyesters. J. C. Petropoulos (to American Cyanamid). 2,979,486.

Fluorocarbon copolymers. E. S. Lo (to 3M). 2,979,489.

Cross-linking of polymers. F. W. West (to 3M). 2,979,490.—**End**

New from Emery Research

4 New Polymerics

Emery research has achieved a significant breakthrough in the field of polymeric plasticizers. Four new polymerics have been introduced to complement Plastolein 9720, the industry's largest selling polymeric. Together, they now give you a single source for a wide range of your plasticizer needs. Although Plastolein 9720 will continue to be the choice in uses demanding its ease of processing and low viscosity, the four new plasticizers meet other needs:

Plastolein 9722: An improved version of Plastolein 9720 in humidity and outdoor aging, compatability, extraction and migration—at the same low cost. (Formerly Emery 3282-D)

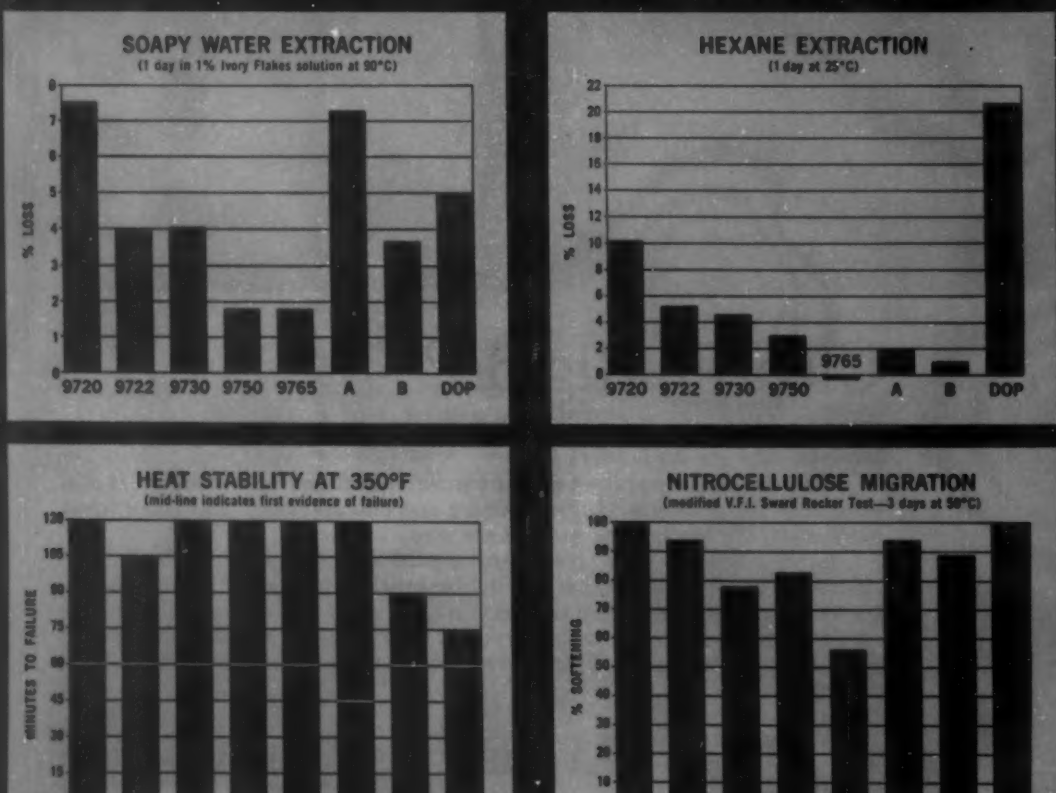
Plastolein 9730: Now, the lowest cost polymeric plasticizer featuring low migration properties, excellent outdoor stability, and good soapy water resistance. (Formerly Emery 3311-D)

Plastolein 9750: A good, general-purpose, medium molecular weight polymeric at low cost, with excellent soapy water extraction and outdoor stability. (Formerly Emery 3313-D)

Plastolein 9765: The medium molecular weight polymeric plasticizer offering the best all-around permanence. Its cost is low, humidity aging outstanding, and extraction resistance tops. Special deodorized grade available. (Formerly Emery 3314-D)

Extensive aging tests have been conducted by the South Florida Test Service. The Emery polymerics were compared with two leading competitive plasticizers and with DOP. Results show outstanding superiority of the Plastolein polymerics. Full information on the new Plastolein Polymeric Plasticizers including reproductions of test samples is available in Technical Bulletin 424. Write Dept. F-7.

Check Plastolein Polymeric performance on eight



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Coated upholstery fabrics	•	•	•	•	•
Unsupported films	•	•	•	•	•
Baby wear	•	•	•	•	•
Wall coverings	•	•	•	•	•
Vinyl-metal laminates	•	•	•	•	•
Industrial tapes		•	•	•	•
Shoe constructions	•	•	•	•	•
Surgical tapes				•	•
Plastisols, organosols	•	•	•	•	•
Coated paper	•	•	•	•	•
Pigment grinding	•	•		•	•
Refrigerator gaskets					•
Flooring	•	•	•	•	•
Hospital sheeting					•
Crash pads				•	•
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Emery

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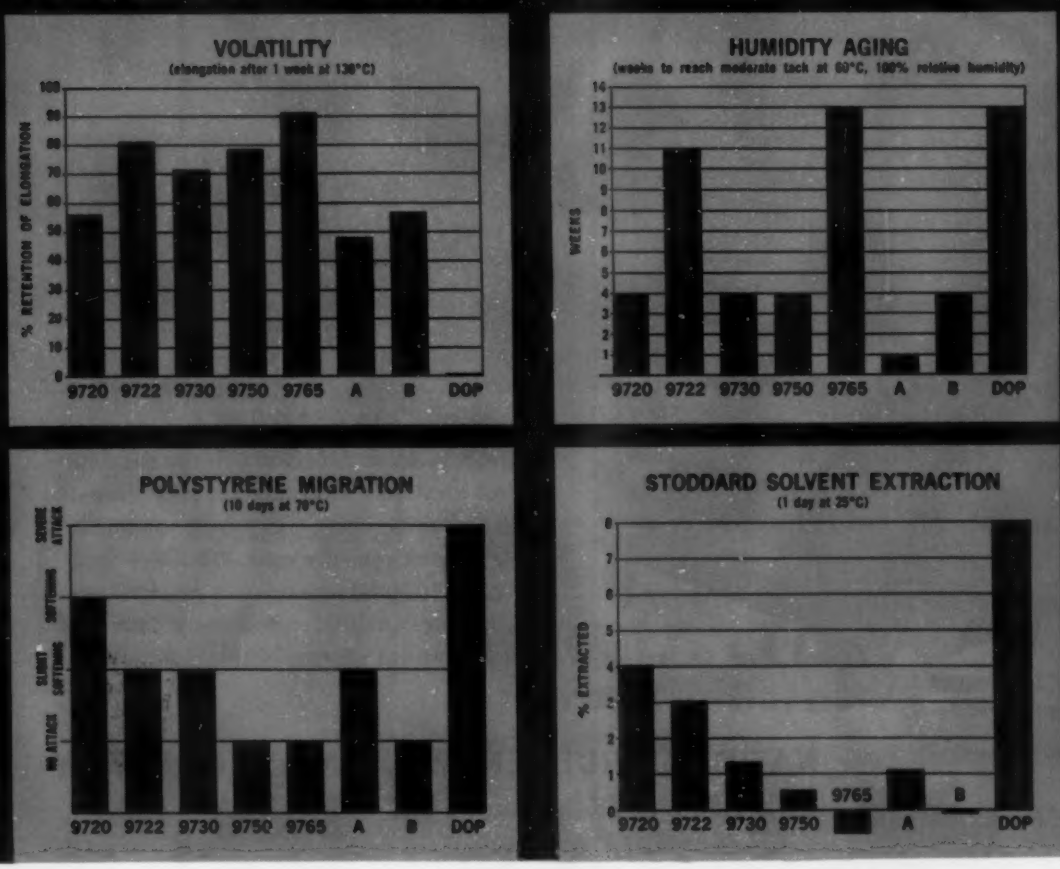
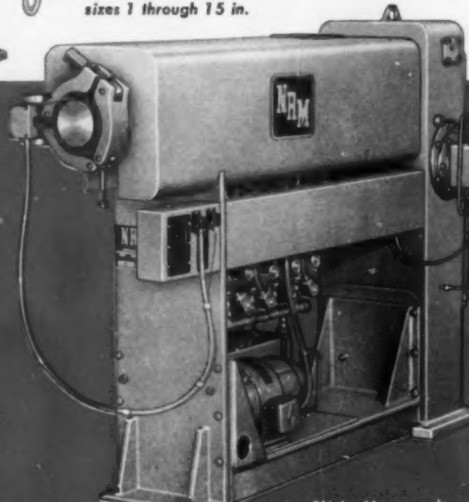


thermoplastics extruders • extruder-dryers • custom extruders for special processes • extrusion accessories • complete package units for production of rigid sheet, plastic pipe, flat or blown polyethylene film, and for wire coating

4½ in. Pacemaker

PLASTICS EXTRUDERS

sizes 1 through 15 in.



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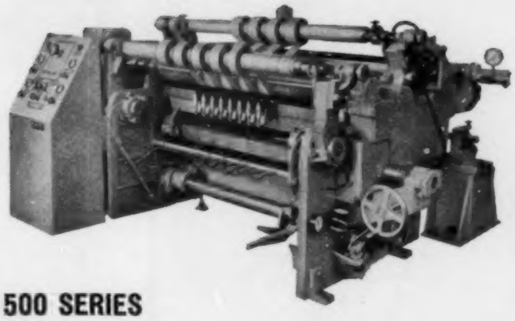
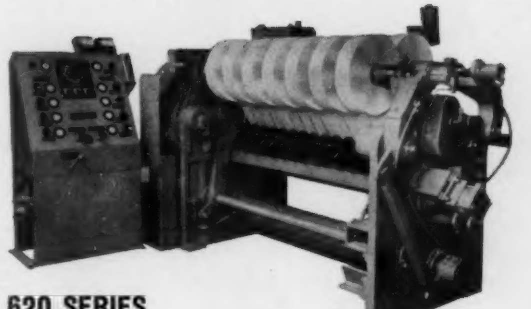


500 SERIES

A standard, multipurpose duplex slitter-rewinder for papers, films, foils, fabrics and other web materials. Speeds to 2000 fpm. Trim widths to 62". Rewind diameter to 20" maximum. Combination surface-center rewind using the differential driving principle. Rolls alternately wound on separate shafts. Score, shear, or razor cut, single or in combination. Also, Sealcut® electrically heated slitters.



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A heavy-duty duplex slitter-rewinder for papers, films, foils, laminates and other off-caliper materials. Speeds to 1000 fpm. Trim widths 32" to 72". Rewind diameter to 20" maximum. Combination surface-center rewind using the differential driving principle. Rolls alternately wound on separate shafts. Score, shear or razor cut. Can also use Sealcut® electrically heated slitter elements.

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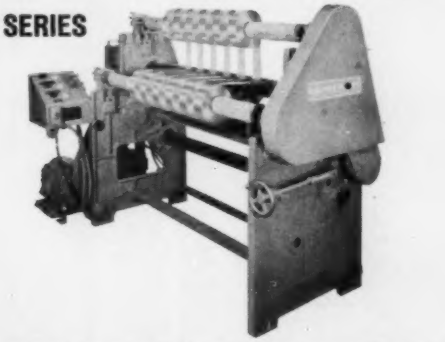
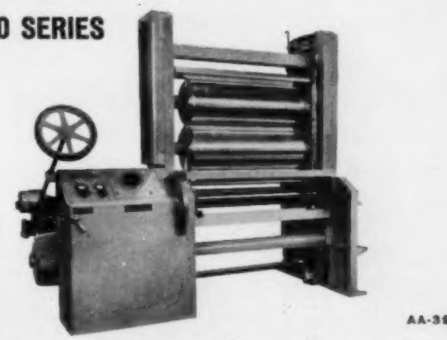
550 SERIES



A light versatile, low-cost slitter-rewinder for films, foils, papers and other materials. Speeds to 500 fpm. Trim widths 32", 42", 52" or 62". Rewind diameters to 15" maximum. Center winding using the differential driving principle. Rolls alternately wound on separate shafts. Choice of razor, score or shear-cut slitting. Integrated unwind with air operated brake and manual side shift control. Optional built-in pneumatic edge guide.

400 SERIES



AA-394

A versatile, highly productive two-drum slitter-rewinder shown here in use as a foil separator for handling lightweight 2-ply foil, with each ply winding on a separate shaft, each rewound roll 15" maximum diameter. The 400 Series is adaptable to a wide variety of other materials. Speeds to 1000 fpm. Trim widths 32", 42", 52" and 62". Rewind diameter (single roll) 30" maximum. Two-drum surface winding. Choice of pneumatic score-cut or shear-cut.

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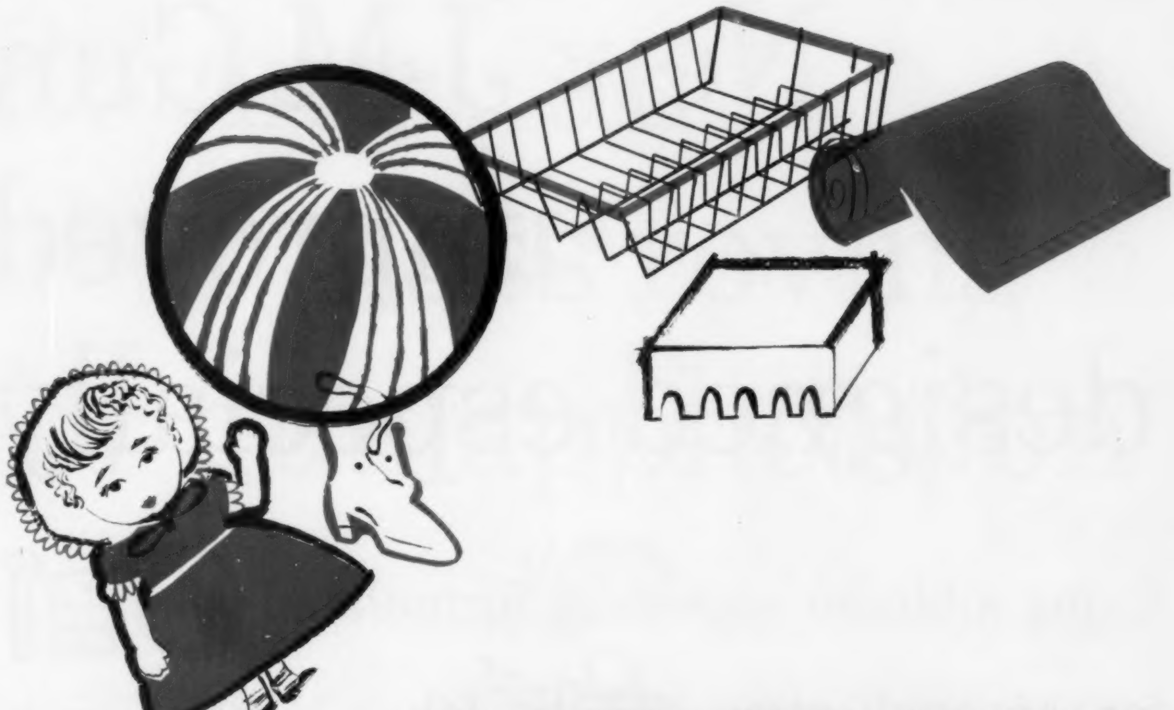

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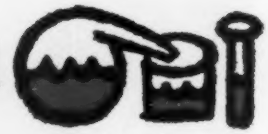
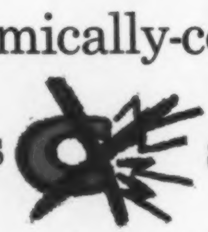
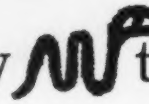
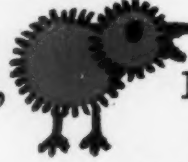
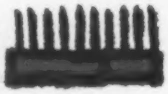
Using a binder especially formulated 
for this application,  Johns-Manville Gun
Roving has chemically-controlled chopping char-
acteristics. It is  static-free, chops 
cleanly, and lays down  evenly without
clumping. It conforms readily  to sharp radii
and intricate shapes because it is soft,  not
stiff  and wiry like other products of this
type. It wets out  quickly  with

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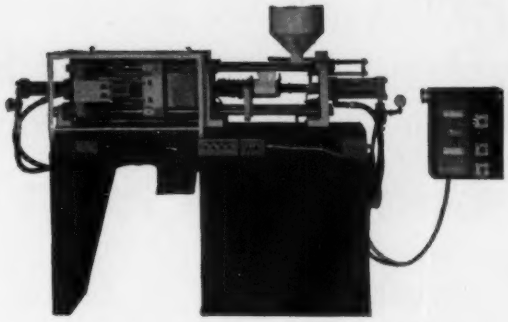

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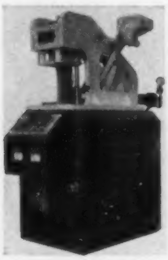

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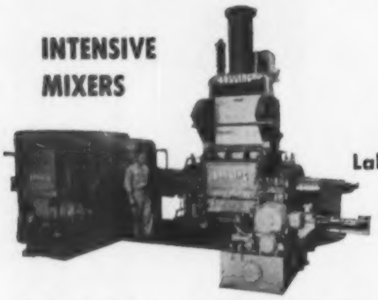

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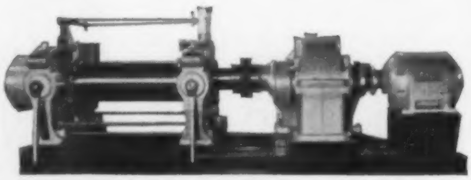

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Slabside • 20" x 20" through 48" x 48"
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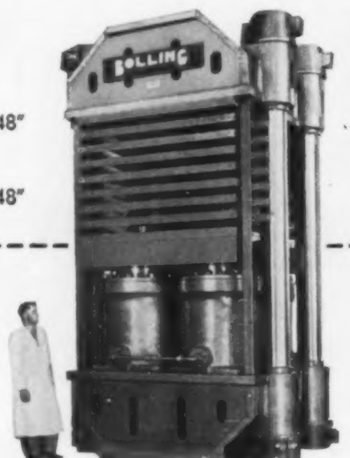
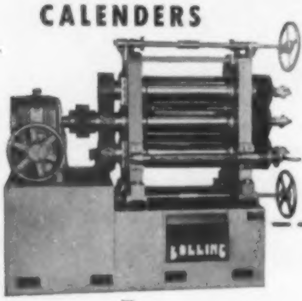
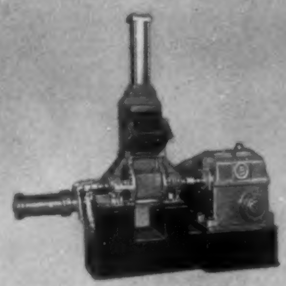


CALENDERS



2-roll	8" x 16"
3-roll	through
4-roll	22" x 62"



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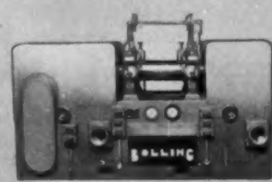

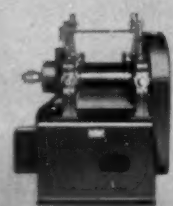

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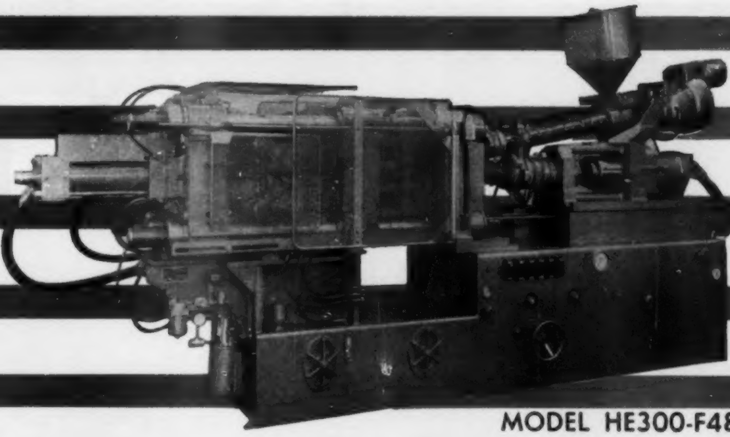

MODEL HE300-F48

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IMPCO
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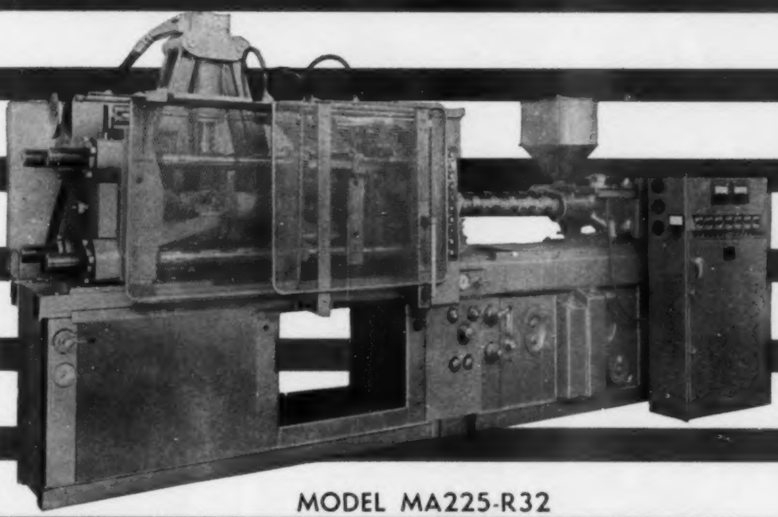
MACHINES



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MODERN PLASTICS

July 1961 Volume 38, Number 11

All eyes on the newer materials

At the plastics shows in New York, Ghent, and London one fact of interest was obvious: the newer, stronger, more heat-and-chemical-resistant plastics materials received most attention.

There are two reasons for this. First, new applications in the building, automotive, appliance, electronic, and packaging fields demand better materials for engineering. Second, these newer materials are reasonably expensive and everybody concerned stands a chance to profit. Their pricing is not subject to buffeting by threat of overcapacity, by wild competition, or by wheeling and dealing in the market.

Since these new polymers, copolymers, and alloys bear higher mark-ups, material makers can afford more development expenditures to promote their use. Processors can afford better engineering for their application. And since they are moving into many markets long dominated by metals, good engineering is required.

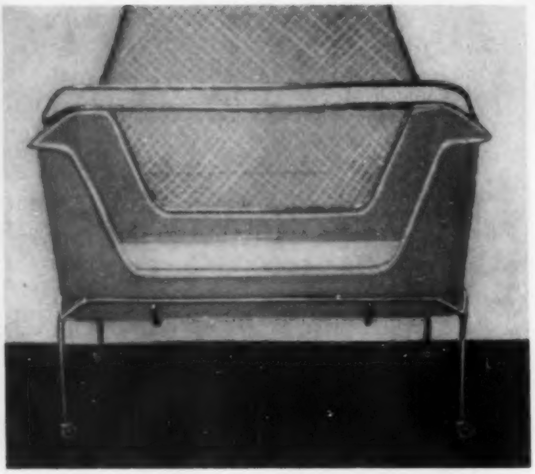
The growing excitement in industry about the acetals, the polycarbonates, the pentaerythritols, the propylene combinations, and the super-high-density ethylenes is not generated merely because of their newness. It is because each of them can do something better than any other materials. And because of their value, they merit this attention.

Coming through laboratories are more new and superior materials and combinations of materials. They will do things that no present materials can do and they will be even more expensive in terms of cost per pound. But in terms of engineering value they will provide properties much needed for the industrial and consumer products of tomorrow. The whole plastics industry, with the greatest range of material properties known to man, continues to move into more sophisticated areas of engineering, design, and application. All eyes must always be focused on the new materials.

NEW ADDRESS: Executive, Editorial, and Advertising headquarters offices of MODERN PLASTICS are now located in our new building at 770 Lexington Ave., New York 21, N. Y. Telephone and teletype numbers remain the same: Phone, PLaza 9-2710; teletype, TWX-NY 1-3063. Cable address: "Breskinpub, New York."

HOPPER LOADER powder molded of polyethylene has 250-gal. capacity, is here being used to feed powder into molds that are located on the floor below.

POWDER MOLDING



BABY CRIB has powder molded body mounted on tubular legs. Made by Memphis Furniture Corp., the complete unit retails at $39.50, and represents the first powder molding application in furniture field. Shape of molding suggests similar gondola-type products for amusement park use.

In little over a year, powder molding has staked out for itself an undisputed place among the various plastics processing techniques, and the question now being asked at end-user level is: "How can I benefit from it?" At processor level it's: Exactly where does this new technique fit in with the various other methods: injection molding, extrusion, fabricating, reinforced plastics molding?"

Several factors will influence a decision to go to powder molding: size of part, length of run, properties, wall thickness, and tolerance. These are discussed starting on p. 152. Generally speaking, however, the process makes possible parts in sizes and quantities beyond the capabilities and/or economies of other processes.

Judging by the products already on the market, powder molding is going to be an important factor in the field of large tanks and materials-handling containers; and, once the design potential of the process is fully realized, penetration of the consumer market can also be expected. Already being produced are premium baby cribs, tackle carrying cases, and boats.

So far, low- and medium-density polyethylene is the resin that is used, and market goals are primarily in industrial and institutional applications requiring a high degree of sanitation and corrosion resistance.

Typical of this field is a group of wastebasket liners molded of low-density polyethylene by Commercial Div., Rubbermaid Inc., Wooster, Ohio. Made in round and square models, these liners—which the company carries as proprietary items—range in capacity from 13½ to 50 gal., and in price from $7.75 for the 13½-gal. round to $20.20 for the 50-gal. square. They nominally replace galvanized steel, with which they are nearly competitive in price, but whose properties they exceed in many respects. For instance, cola drinks will literally eat through galvanized steel in a matter of a few weeks. Many of these waste receptacle units are used in connection with vending machines, in drive-ins, and other locations where corrosion resistance is an extremely important consideration. At the same time, the powder-molded liner is only a fraction of the weight of the steel unit, and it is flexible enough so that it cannot be permanently bent out of

IS STARTING TO MOVE

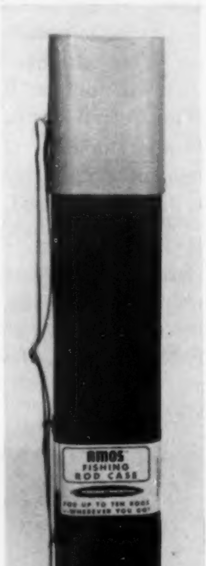
Economics of process, derived from size of parts and length of runs, assure this method a strong position among the other plastics processing techniques

SAIL BOAT has molded-in centerwell to accommodate center board. Length is 9½ ft., beam is 48 inches. Powder-molded boats up to 25 ft. are already on the drawing board.

shape. Another promising item in the company's line is a series of floor trucks ranging in size from 6 to 14 bushels. The 14-bu. unit, equivalent to 110 gal., is list priced at $95.70, including a polyethylene-coated steel frame and four 5-in. roller bearing casters. In this case, powder molding permitted production of a seamless molded part of a size beyond the present capabilities of injection molding. Medium-density resin was used.

The truck line is being pointed at four major market areas: laundries, food and chemical processing, and various uses in department stores.

Since corrosion-resistant service is one of the prime market targets for powder-molded polyethylene products, the problem of stress-crack resistance assumes major importance. In this respect the process offers some important advantages. In powder molding, the processor does not particularly look for ease of flow. On the contrary, he needs a material with low sag tendencies, and can thus use low-melt index resins, which are considered to have the best in stress-crack resistance characteristics. Since some flow



ROD CASE, which looks like a big rectangular extrusion, is capped at each end with flexible vinyl sleeves that are adjustable to accommodate various rod sizes. Diamond pattern molded into outside surface of powder-molded unit is impossible to achieve by extrusion process.

Photos, Amos-Thompson Corp.

POWDER MOLDING—

Who does it and how

The big impetus to powder molding in this country came early last year with Spencer Chemical Co.'s introduction of the Thermofusion process of powder molding and U.S.I.'s announcement of Microthene PE powder production. The patented process, which had attained a fair degree of popularity in Europe under the name of Engel process, consists essentially of fusing finely divided resin (about the consistency of table salt) in comparatively low-cost sheet metal molds. Four processors are currently using this technique under license from Spencer: American Agile, Amos-Thompson, Rubbermaid, and Space Structures. Fairly large ovens are used to accomplish the fusion of the resin, and the size of the product is limited by the dimensions of the oven. The largest oven currently in use is 25 ft. high. The basic steps of the Thermofusion process were described in "Large-size objects with low-cost tooling," MPl, March 1960, p. 86.

Powdered resin in commercial quantities is currently being supplied by U. S. Industrial Chemicals and Spencer. (Actually, all polyethylene producers could supply powder.)

Prior to Thermofusion, Delaware Barrel & Drum Co. used a powder molding technique known as the Heisler process. This method uses heated molds and also a wiping action to produce either round or rectangular parts.

Beyond these two patented processes, work is also being done on a technique that sprays the fine powder against heated mold walls; but this technique is still in the developmental stage. In addition, Akron Presform Mold Co., Cuyahoga Falls, Ohio, has just announced a new technique for rotationally molding polyethylene powder, using equipment similar to that used for plastisols. The company claims that this new method offers significant economics over both rotationally molded plastisol and blow-molded PE. (Details will be presented in a forthcoming issue.)

In terms of the number of units produced, powder molding represents a small market. However, in terms of resin tonnage processed, it may reach sizable proportions. Most powder-molded items are large; 100 lb. of resin per unit is not unusual. It would take only 10,000 units to bring resin consumption to 1 million pounds.

Since most powder-molded production did not get underway till the middle of this year, estimated consumption for 1961 will probably only run 500,000 to 1,000,000 pounds. However, by 1965, this technique is expected by some observers to account for at least 5 million lb. of resin . . . although less optimistic spokesmen prefer the figure of 2 million pounds.—**End**

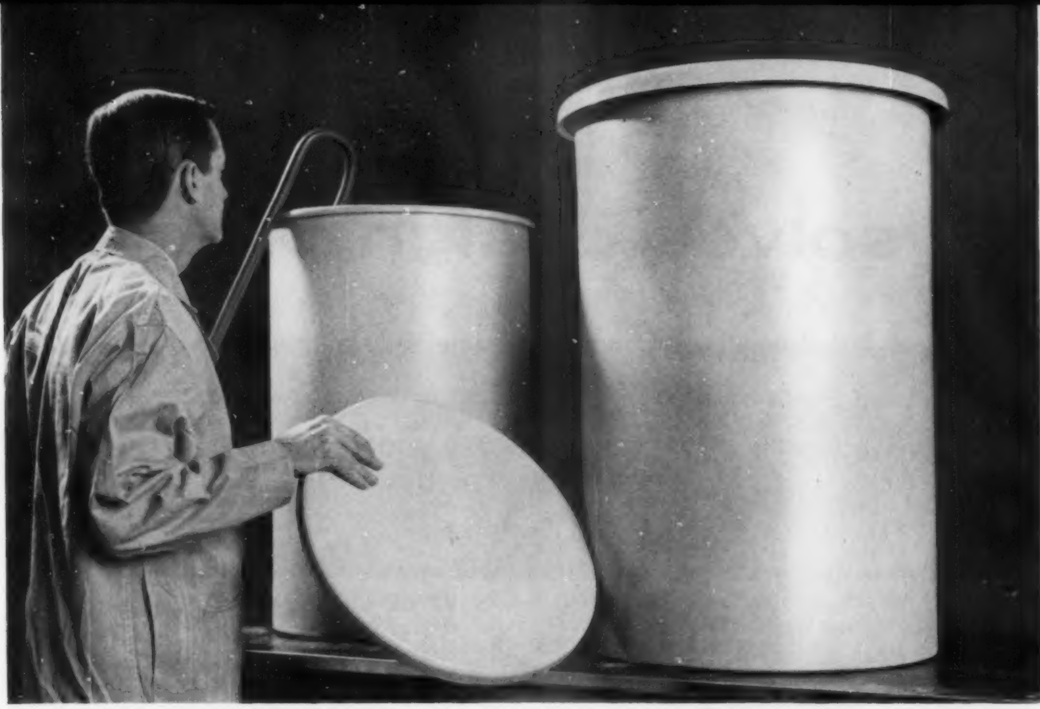
is involved in fusing the powder, it is not feasible to use the lowest melt index. Processors have found that an M.I. of 1 or 1.5 gives the best results. If the application is not critical, slightly higher values may be used. Food processing is apparently slated for an extremely heavy influx of powder-molded containers. And in addition to floor trucks, several food handling containers are being offered by Thermofusion Div., Space Structures Inc., Chanhassen, Minn. Sizes range from 12½ to 150 gal., and the units generally replace metal, wood, enamelled, and/or stainless steel. According to the company, powder-molded containers in these capacities cost only one-third as much as stainless steel and half as much as aluminum.

Chemical processing is another promising market area. American Agile Corp., Bedford, Ohio, which has long serviced this industry with welded sheet products, is now also powder molding, on a custom basis, tanks and containers in sizes up to 350 gal. (self-supporting). In addition, the company is doing some interesting work in the missile and electronics field. Pointing up the versatility of the process, the part pictured on p. 83 shows how intricate angular projections can be powder-molded. This particular piece was used to mold solid fuel for rocket use. The conical shape shown below measures 18 in. long and has a diameter of 24 in. at its widest point. It serves as an insulation sleeve for a radarscope and, prior to powder molding, was made by welding. This part has to withstand 60,000 v., and even the minutest flaw could lead to breakdown. With welded seams, such flaws might well occur. Powder molding results in a smooth, seamless structure that is not likely to break down at the voltages being used.

Among the advantages offered by powder

INSULATION CONE for radarscope, formerly fabricated by welding sheet, is now powder molded to avoid electrical breakdown which occurred at seams.

Photo, American Agile



BARRELS AND COVERS produced by Delaware Barrel & Drum Co., using a technique involving heated and rotating molds. Company buys low-density polyethylene pellets and then grinds them up into powder. Photo, Eastman Chemical Products Inc.

molding is the fact that reinforced ribbing, decorative designs, and metal inserts can be easily molded into the product. With sheet welding this is not feasible, and in the sizes involved, it is not economical with injection molding.

A good example of this is a hopper-feeder powder-molded by Sintrex Div., Amos-Thompson Corp., Edinburg, Ind. Made of medium-density PE, the hopper measures 44 in. in diameter at the top, 54 in. high, and 5 in. at the bottom; it incorporates a molded-in stainless steel throat through which the material feeds. Capacity is 250 gal., weight is 85 lb., and the price is $95. The hopper is so designed that an extension unit can be mounted on top to double the capacity. Ribs molded into the wall and funnel section provide structural strength. The item has turned out to be so efficient that Amos **(To page 150)**

Photo, American Agile

ROCKET FUEL MOLD, powder molded of low-density polyethylene, incorporates several sharp, fin-like projections, which are extremely hard to produce by welding.

FLOOR TRUCKS, powder molded of polyethylene, offer sanitation, corrosion resistance. quiet operation, minimum maintenance—all at a reasonable cost. Unit with capacity of 110 gal. retails for $97.50, with frame and casters. Photo, Rubbermaid Inc.

RP solves design problem

Light weight and strength are standard characteristics of reinforced plastics, but Boeing aircraft engineers were more interested in flexibility under stress in using this material in the wing of the new 720 jet transport

A basic advantage of reinforced plastics (RP) is the fact that the strength and other physical characteristics of the finished laminate may be controlled through choice of resin, reinforcing agent, and fabrication technique. Normally, the objective when using RP is to achieve a structure with absolute maximum strength combined with minimum weight. But engineers at Boeing Airplane Co., in designing the wing structure for the new Boeing 720 Jet Airliner, turned to RP for a different reason: to obtain the required elasticity, or flexibility, they needed for certain sections of the wing surface.

To achieve desired aerodynamic characteristics, the Boeing 720 wing has been designed with a broad fairing at the point where the leading edge blends with the fuselage. As the wing flexes in flight, the wing surfaces and fairing are subjected to compressive and tensile stresses. In terms of the fairing the most critical is the compressive stress.

The desired aerodynamic characteristics necessitated a larger and deeper wing section between fuselage and the nacelles of the inboard engine. This could have been achieved by a complete redesign of the structural wing box in this area, but this method was rejected because of the large retooling costs entailed. It was decided to use the basic wing box as it existed and obtain the desired modification in section by "fairing" the basic section.

It was soon realized that the use of a fairing of aluminum alloy—the standard material for aircraft surfaces—would necessitate some form of slip joint to prevent overloading. This type of joint would have been very complicated and expensive, and probably not reliable. An alternate course was to choose a material with a low modulus of elasticity but stiff enough to transmit the air load pressure to the basic wing box. The material which best met these specifications was reinforced plastics.

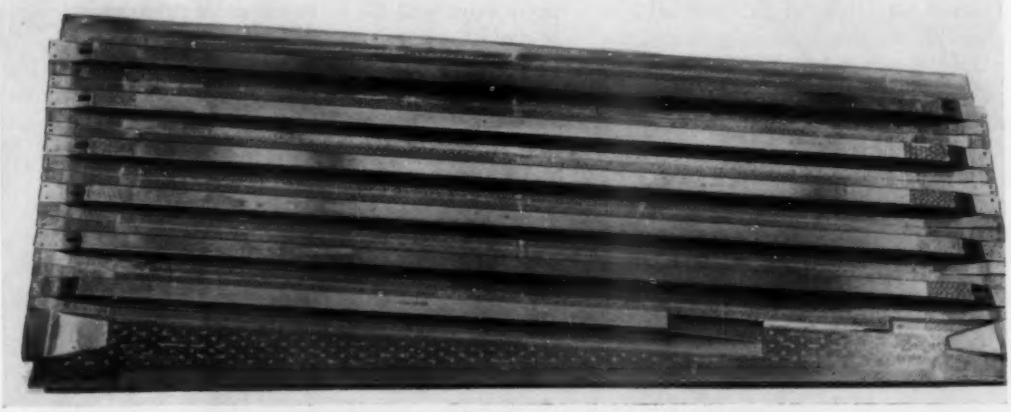
As finally designed, the upper fairing surface consists of 10 separate reinforced plastic panels. The individual panels are fabricated at Boeing's metal bond shop, but the assembly of the panels into the complete fairing surface is performed at the aircraft assembly plant in Renton, Wash.

Calculations indicated that the optimum range for the compressive modulus of elasticity of the material had to be between 2.5 and 3.2×10^6 p.s.i. and the ultimate compressive stress had to exceed 30,000 p.s.i. Tests showed **(To page 155)**

MOLD for prepreg hat-section struts (right) of fairing panels assembled and ready for vacuum-pressure curing. PVA film is used as mold parting agent. Completed panel (far right) seen from underside. Hat-section struts have been bonded to underside of panel skin.

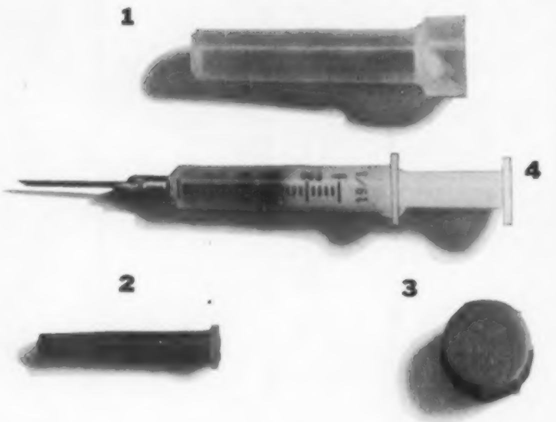
for jetliner wing

RP FAIRING (light color) extends from fuselage to inside engine nacelle along leading edge of jetliner's wing. Smaller, square-shaped panels shown in different shading, consist of phenolic blocks bonded to aluminum wing behind RP panel for streamlined aerodynamic continuity.



THREE COMPLETE hypodermic syringes as packaged. Note the different shades on needle sheaths and caps, for color codings. Disassembled unit shows component parts of syringe and package: 1) polypropylene protective sleeve, 2) polypropylene cap which is heat-sealed to the sleeve, 3) a high-density polyethylene needle sheath, and 4) polypropylene syringe barrel and high-density PE plunger.

WHY THEY SPECIFIED



Each year in the United States more than 2 billion hypodermic injections are administered. Each year, too, about 1⅛ billion ink cartridges are sold for ball-point pen refills. Also, there is a constant need in medical research facilities for test tube holders—up to 30,000 per year.

These seemingly unrelated facts *do* have one thing in common: polypropylene is making serious overtures in each of these high-volume markets!

Just imagine the plastics poundage involved in polypropylene hypodermic syringe components, in ball-point pen barrels and refill cartridges, and in test tube racks. If polypropylene were to capture a good share, say 10%, of the potential 100 to 110 million lb. inherent in these products, the result would be a healthy 10- to 11-million-lb. boost in polypropylene consumption! And, from successes already chalked up in the application areas cited above, it now appears likely that polypropylene will indeed get that boost.

What makes polypropylene so desirable for these uses? There are three important reasons—economics, properties, and design flexibility. All three are important in any instance, of course, but the relative importance of each characteristic may vary with each application, as is illustrated by the following case studies.

Economics: syringe components. Economics have been all important in the 2½-cc. hypodermic syringes recently introduced by Roehr Products Co. Inc., DeLand, Fla. That's because the products are designed to be disposable, offering greater safety to the patient by eliminating possible contamination from re-used syringes. And the prerequisite for disposable products is, of course, low initial product cost.

Determination of a unit cost for the new disposable syringe was based upon the cost of preparing a conventional syringe for re-use. For many years, the standard material for syringes has been ground glass, and a quality syringe of this material ranges in initial cost from $1 to $1.75. A glass syringe is generally re-used about 20 times, necessitating re-sharpening of the needle and sterilization of the entire unit by steam bath or dry autoclaving methods at temperatures of 165 to 250° F. Each time these operations are performed, the cost to the hospital or medical facility comes to about 8¢ per syringe. Therefore, the latter figure was used by Roehr as a benchmark in developing its disposable plastic syringe—which sells at a price competitive with the cost of a single reprocessing of a glass syringe.

Plastics, of course, were considered in terms of making possible the low initial cost, but the resin chosen had to possess all the desirable features of glass, including transparency and material uniformity. Polypropylene was especially desirable for this medical application because of its inertness to known drugs and its resistance to chemicals used to sterilize syringes after assembly.

The resin offers a number of inherent advantages,
but in each of three new applications
there was one overriding reason for its choice

POLYPROPYLENE

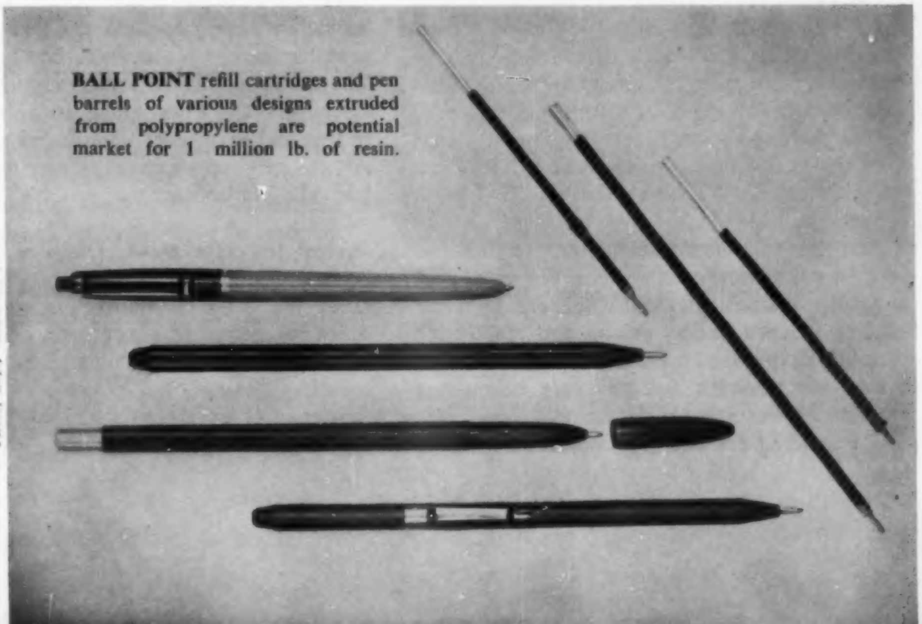
Also on the plus side is a low packaging cost permitted with polypropylene.

A complete plastic syringe consists of six individual components. In addition to the stainless steel needle with its aluminum hub these include: 1) a polypropylene barrel; 2) an outer protective sleeve of PP; 3) a PP cap for the sleeve; 4) a needle sheath of high-density polyethylene; and 5) a high-density polyethylene plunger, which is equipped with an inert rubber tip and coated with silicone to permit its smooth operation in the barrel of the syringe.

Color for coding of needle gages is molded into the sheath and the sleeve cap. A heat seal holds the cap to the sleeve until the syringe is ready for use. This unbroken seal, together with complete encasement of the syringe by sleeve, cap, and needle sheath, assures a completely sterile unit. To open the package, the user simply raps the syringe, on its needle sheath end, on a hard surface, breaking the seal and loosening the cap.

All told, the polypropylene parts of the new syringe weigh less than 1 ounce. But considering the more than 2 billion injections given yearly, a major penetration of this medical area could translate into an 8-figure poundage market for polypropylene resin.

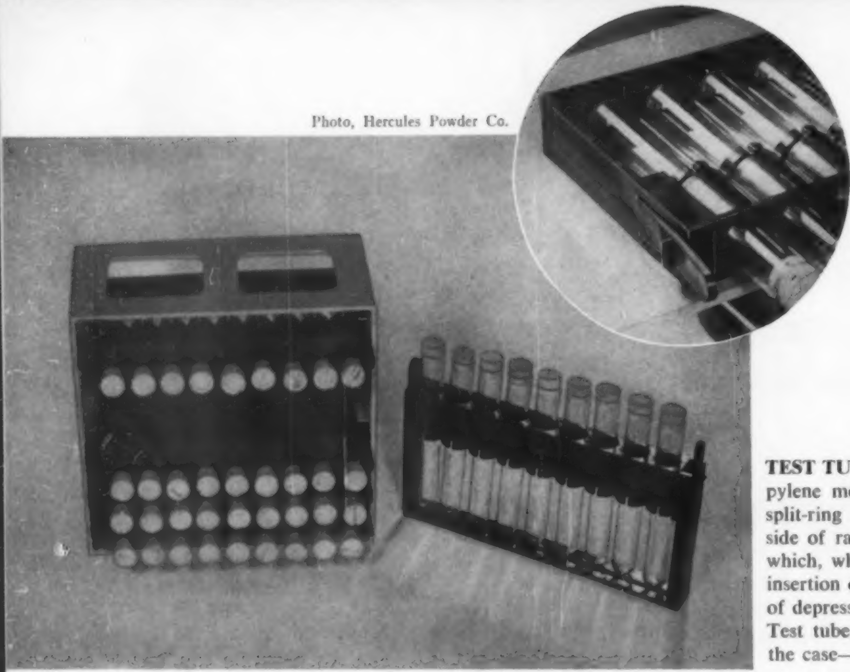
Injection molding of the syringe barrels and the hot stamping operations are done by Roehr, which uses Escon polypropylene supplied by Enjay Chemical Co. The polyethylene plungers are molded by Atlantic Plastics, Stamford, Conn., which also shares molding of the PE needle sheaths with The West Co., Phoenixville, Pa. Molding material for these parts is supplied by Phillips Chemical Co. and W.R. Grace & Co., Polymer Chemicals Div. Polypropylene sleeves and sleeve caps are molded by West, which uses



BALL POINT refill cartridges and pen barrels of various designs extruded from polypropylene are potential market for 1 million lb. of resin.

Photo, Enjay Chemical Co.

Photo, Hercules Powder Co.



TEST TUBE RACK (right) is a one-piece polypropylene molding, holds nine test tubes securely in split-ring retainers. Integrally molded into one side of rack is a pressure flexural strip (see inset) which, when depressed by finger pressure, permits insertion of the rack into the case at left. Removal of depressing force locks rack into the plastic case. Test tubes can be emptied simply by overturning the case—the tubes will not fall out.

Pro-fax material that is obtained from the Hercules Powder Co.

Properties: ballpoint pen parts. The history of materials tried or used at one time or another for ballpoint pen barrels and ink refill cartridges would look like a plastics primer. Now it appears that polypropylene, because of many excellent properties and qualities, has established itself as the material to beat in this market!

An early extruder of plastics materials for pen barrels and for ink refill cartridges, Action Div., Colorite Plastics Inc., Paterson, N. J., has now decided to run its entire line in polypropylene. The materials previously tried by this company, and the reasons for their ultimate withdrawal, include: cellulose acetate, which had a strongly adverse reaction from contact with oils in the various ink formulations; cellulose acetate butyrate, which had a high tendency to absorb ink, thereby reducing the usable ink volume; extruded brass, which proved to be too costly; rigid polyvinyl chloride, which proved too costly on a parts-per-pound basis; conventional polyethylene, which turned out to be too flexible; and high-density PE, which lacked resiliency.

According to the manufacturer, the material used for pen barrels must combine proper degrees of rigidity and resiliency if it is to stand up under bending induced during writing and still spring back into shape when released. Extruded polypropylene has provided the necessary balance of mechanical properties in the barrels.

The material has also been modified by Action to withstand attack from inks now used in the refill cartridges and in a line of polypropylene-housed stick pens. The new PP does not cause the inks to coagulate and clog as do many of the other thermoplastics tested. In addition, costs are kept to a minimum because polypropylene's low specific gravity of 0.905 affords a higher unit yield per pound of material.

It is estimated by officials at Action that its share of the pen barrel and refill cartridge market represents a potential to polypropylene of from 750,000 to 1,000,000 lb. per year, with actual-use poundage rapidly approaching this potential. And the 1⅓-billion-unit figure for ink refill cartridges alone means that polypropylene can go a long way in the over-all ballpoint market if Action's estimates prove correct.

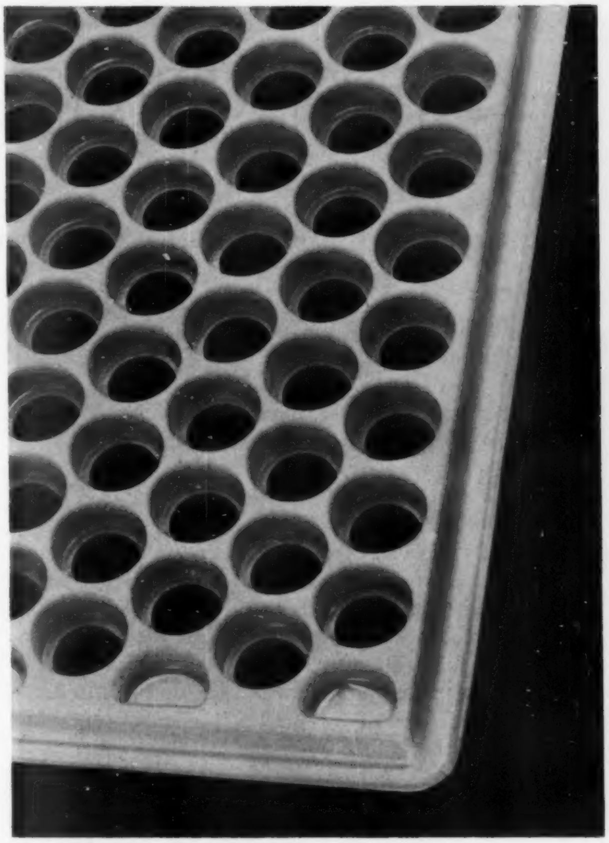
The pen barrels and refill cartridges are extruded by Action on 2½- and 3½-in. machines manufactured by National Rubber Machinery Co. The extrusion material used is furnished by Enjay Chemical Co. After filling with ink, the cartridges and barrels are centrifuged to remove all air, an operation which permits up to 98% of the ink to be available for use.

Design: test tube racks. Designed by Advance Scientific Corp., Philadelphia, Pa., these test tube racks are molded entirely of polypropylene, which has permitted incorporation of several new handling features. The ability of PP to withstand countless flexings, for example, made possible the design of an integrally molded pressure hinge on one side of the rack. **(To page 158)**

New approach to design of light diffuser

Vacuum-formed vinyl sheets heat-sealed together with vinyl interlayer improve efficiency, add strength, reduce weight

In devising a construction for a diffuser to meet the immediate needs of the lighting industry, Cirvac Plastics, Erie, Pa., has come up with a unique type of panel that should prove of equal interest to other segments of the building trades. The finished vinyl panel, based on a modified "sandwich" construction, not only has good diffusing characteristics, but is light in weight, self-extinguishing, rigid and strong enough to be self-supporting, and can be designed in a variety of distinctive three-dimensional textures and effects.



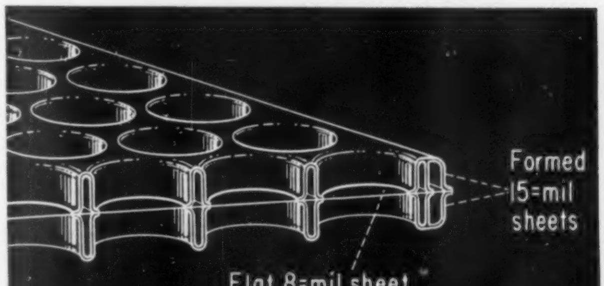
COMPLETED DIFFUSER in close-up shows how flat sheet is punched out to form light-transmitting openings. Narrow rim around center of openings is sealing point at which two formed sheets and flat sheet are joined.

Sheets sealed together

The light panels, which are used in luminous ceiling installations, are produced by vacuum forming 15-mil rigid vinyl sheets in a pattern of closely spaced circular depressions, ¼-in. deep and ½-in. in diameter. Two of these formed sheets with the flat bottom of the depressions fitted back-to-back are then electronically heat-sealed together in "sandwich" fashion with a flat 8-mil vinyl sheet as the center layer. Sealing is at the edges of the sheets and around the periphery of each of the so-called "louvre cells."

The use of the vinyl interlayer, or "membrane," adds sufficient rigidity to the construction to make the panels self-supporting, despite the thin-gage materials involved. Heretofore, the problem of rigidity has been solved by increasing the thickness of the vinyl sheet—and obviously decreasing its lighting efficiency.

Further emphasizing the design flexibility of the new panels is the fact that (To page 159)

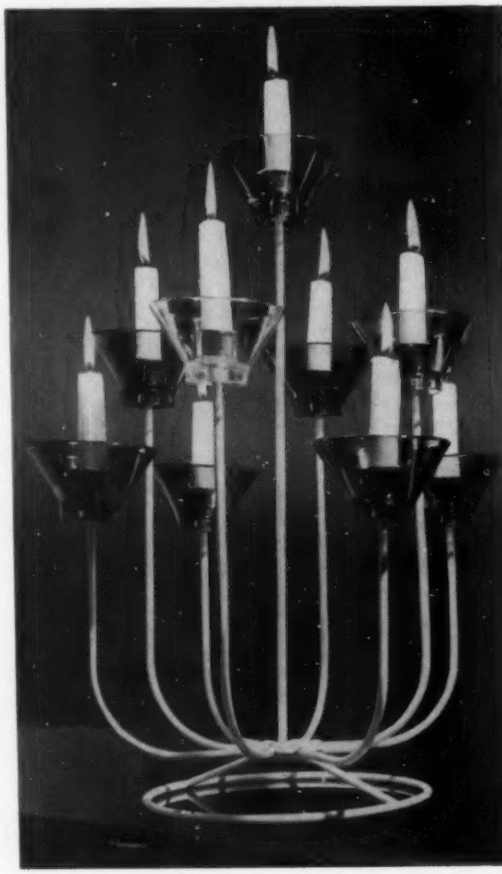


CROSS-SECTION DIAGRAM shows vinyl sheet sandwich assembled into diffuser.

STYRENE INSTEAD

. . . for holders in a candelabrum

The increasing use of styrene as an efficient, economical replacement for glass in a broad range of household products is emphasized by the results achieved through its use in two modern designs—a fancy candelabrum and a line of quality tumblers.



Candelabrum improved, costs cut

By replacing pressed glass cups with injection-molded styrene cups in its Jewel Candolier decorative 9-candle holder, Victrylite Candle Co., Oshkosh, Wis., not only reduced the production and shipping costs, but also upgraded it through the improved appearance, color, and light reflecting qualities of the plastic components.

For some time Victrylite had been using glass cups supported on gracefully rising metal stems for the Candolier. At one period, in order to obtain colored effects, clear glass cups were actually sprayed with an epoxy as part of the manufacturing process. This arrangement proved unsatisfactory because the color tended to separate from the glass in service and during washing. Later, a switch was made to colored glass, but colors were not always uniform. Not only were such disadvantages eliminated by the switch-over to styrene, but also a number of advantages accrued.

Take the problems of production scheduling and glass inventory, for example. No major manufacturer of colored glass would accept an order for less than 60,000 units—a day's vat run—in any one color. Although some of the smaller glass producers would handle smaller orders, with them various other difficulties were encountered. Because of the shorter set-up time for plastics injection molding, Victrylite is no longer required to order from its suppliers in fixed lots, but can adapt its ordering to most efficient plant production and storage requirements.

Shipping and packaging costs have been lowered by the switch-over to styrene. The lighter-weight plastic (each cup weighs 4 oz. less than the glass counterpart) automatically cuts down on freight costs, of course. In addition, the styrene cups can be safely nested, whereas the glass cups required individual wrapping. This makes for less costly, more compact packaging. Less breakage also is experienced with the styrene cups.

Finally, the styrene cups permit faster, more economical assembly. Instead of the rubber grommet formerly used in affixing the glass cups to the metal arms of the Candolier, a less expensive polyethylene collar is used. This fits snugly into a well molded into the bottom of the cups.

But economy was not the only criterion which proved the switch-over from glass to styrene

OF GLASS

. . . for crystal-like household tumblers

worthwhile. Styrene also provides cups of increased brilliancy and permits a wider range of colors to be used.

The new styrene cups, produced in a four-cavity mold, are run on an 8-oz. injection machine. Edge-gated, they have a maximum wall section of approximately 0.170 in., which gives them a quality look and "feel." To eliminate any possibility of difficulty in the event of candle flame contacting the styrene material, an aluminum insert is pressed into position in the bottom of each cup, where the base of the candle is inserted.

Considering the many advantages gained by Victrylite in this switch from glass to styrene, it is not difficult to understand why the company is pleased with the change. And sales of the Candolier with the new plastic cups have been running 33% ahead of the previous year.

Tumblers look like crystal

Lower price and improved performance based on the use of high-heat-resistant styrene has spearheaded the development of a line of household tumblers that have the appearance and elegance of high-fashion, crystal-cut glass.

As they come out of the mold (which is specially hand pantographed and hobbed), the coined-cut clear styrene tumblers resemble crystal—but right there the similarity ends! Pricewise, the styrene tumblers cost anywhere from one-fiftieth to one-tenth as much as their glass counterparts. They are virtually non-breakable in normal use (wall thicknesses run up to 0.375-in.), they can take the heat and impact of mechanical dishwashers, they have smooth, rounded edges for extra safety, and they won't bind or scratch while being stacked.

And, of course, there's the weight factor that always shows up in plastic's competition with glass. On the average, the styrene tumblers weigh about one-fifth as much as glass—a feature that is immediately translatable into reduced shipping costs. And in anticipation of a possible market for the tumblers as a reusable premium package for jams, jellies, cheeses, etc., the manufacturers have also molded into their rims a gentle undercut that can easily accommodate a closure.

A crystal, high-heat-resistant, high-molecular-weight styrene resin with improved flexural and tensile strengths was chosen for the job. Three sizes of tumblers are available: 5-, 9-, and 12-oz.; shot weights for each are respectively 30, 40, and 55 grams. The 5- and 9-oz. tumblers are automatically molded in single-cavity molds in 3½- and 7-oz. machines; the 12-oz. tumbler is automatically molded in a four-cavity mold in a 20-oz. machine. Pin-gated and hot-runner molds are used and cycle times average 12 to 15 seconds.

Expectations for immediate markets for the tumblers in housewares, packaging, and hospital or institutional use are big; potential markets for these tumblers and pitchers are even bigger.

Credits: Candelabrum cups developed and produced by the Walter Frank Organization, Hillside, Ill., using Monsanto's high-heat resistant Lustrex styrene. Molds for cups and polyethylene mounting grommets, Chicago Mold Engineering Co. Inc., Hillside. Tumblers molded by Loma Industries, Fort Worth, Texas, using styrene supplied by Foster Grant Co., Leominster, Mass.—**End**

Broadened markets for polystyrene foam from . . .

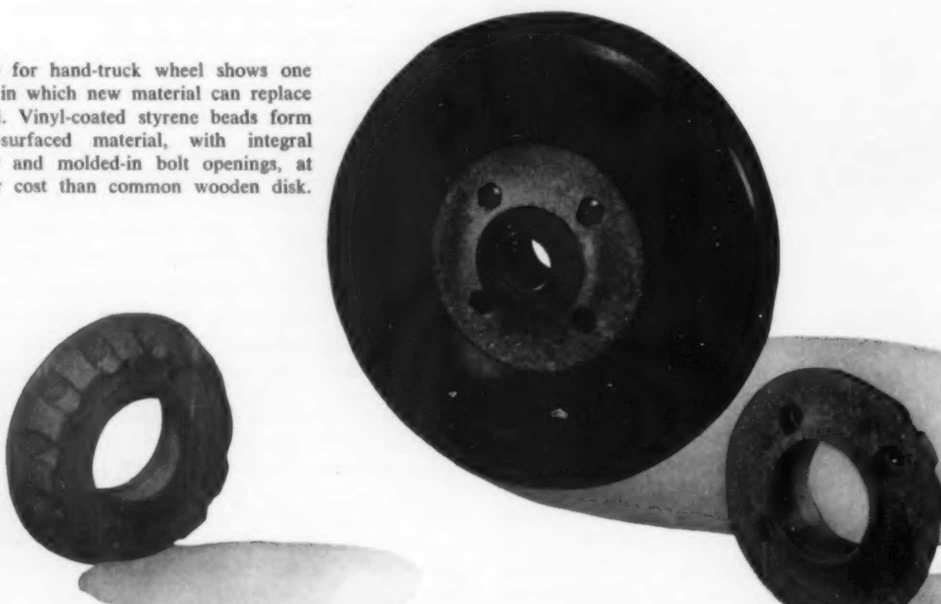
Vinyl-coated expandable

One-shot molding of parts having a low density cellular core surfaced with a rigid skin is now possible with the introduction of a specially processed type of expandable styrene bead having a vinyl-base coating. Handled in essentially the same way as conventional expandable styrene, except that the customary pre-expansion step is eliminated, the material is expected to find applications in numerous fields including floating marine items, packaging, refrigeration, construction, cars, toys, and industrial components.

The thermoplastic skin (beads coated with polyethylene or acrylic are also available), of course, imparts much greater surface hardness to the finished part. It permits finer surface detail, increases the flame resistance of the material (which also can be formulated with flame-resistant expandable styrene), and provides a surface on which paints and finishes which might attack unprotected styrene foam may be used.

The coated expandable styrene beads, which may be supplied either in white or a range of colors, are molded by dry heat, steam, or dielectric heating. The range of densities presently available in end products runs from 5 lb. to more than 35 lb. per cu. foot. Through proper control of molding techniques (design and location of steam probes, length of molding cycle, etc.), it is possible to vary the thickness and location of the skin as desired. For example, overall thickness of the skin on one or both sides of the part can be varied when working with steam chest molding. This is accomplished by delaying injection of the steam to one side of the mold. Depending upon the nature of the specific application, the thermoplastic skin that is produced during the molding operation may range in thickness up to ¼ inch.

Since the material is molded without the usual pre-expansion step used in molding conventional expandable styrene, the density of the molded part is determined mainly by the volume of mate-



HUB for hand-truck wheel shows one area in which new material can replace wood. Vinyl-coated styrene beads form hard-surfaced material, with integral color and molded-in bolt openings, at lower cost than common wooden disk.

COVER: Examples of the exciting colors, cellular patterns, and hard surfaces available through use of new vinyl-coated styrene beads. Lettering in background is part of large "calling card" molded from the material by developer, Keno Plastic Processing Corp., which supplied the material for this photo as well as supplying the other photographs shown on these pages.

styrene beads

rial placed in the mold. Thus, for a part of lower density, a smaller volume of the material is used. Because of the nature of the material, inserts of metal, wood, or other materials may be permanently molded into finished parts, where they are firmly anchored by a layer of thermoplastic skin during the molding cycle.

In general, the material is used with standard, available molding equipment and molds. However, the venting and cycling must be changed to obtain maximum results with the material. No release agent is needed, since the material serves as its own release agent.

Lighter, less costly than wood

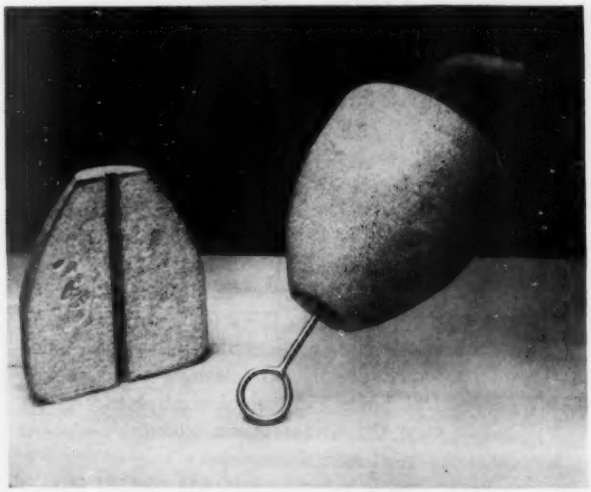
The cost of the specially processed coated beads material is approximately 55¢ per pound in pilot-plant quantities.

Particularly interesting to molders and manufacturers are the economics of the modified expandable styrene material. In general, finished parts molded from it are about one-third less costly than equivalent parts fabricated of wood. In a typical toy item—a small wheel for a pull toy—the finished cost of a fabricated wooden wheel, including painting, is approximately 1¢, as against ⅔¢ for that molded of the new material. Also, the plastic wheel can be molded with interesting design details, whereas the wooden unit is essentially a straight-sided disk. Because the material in average densities is only about two-fifths the weight of wood, important freight savings in shipping are also possible.

Among the interesting applications for which the new material seems to have great potential are the following:

Shoe heels. A typical pair of heels fabricated of wood, for example, costs from 11¢ to 15¢, as against 9¢ for high-density, coated, expandable styrene material. By going to these high densities, heels may be molded which can be securely nailed, using barbed nails of the **(To page 162)**

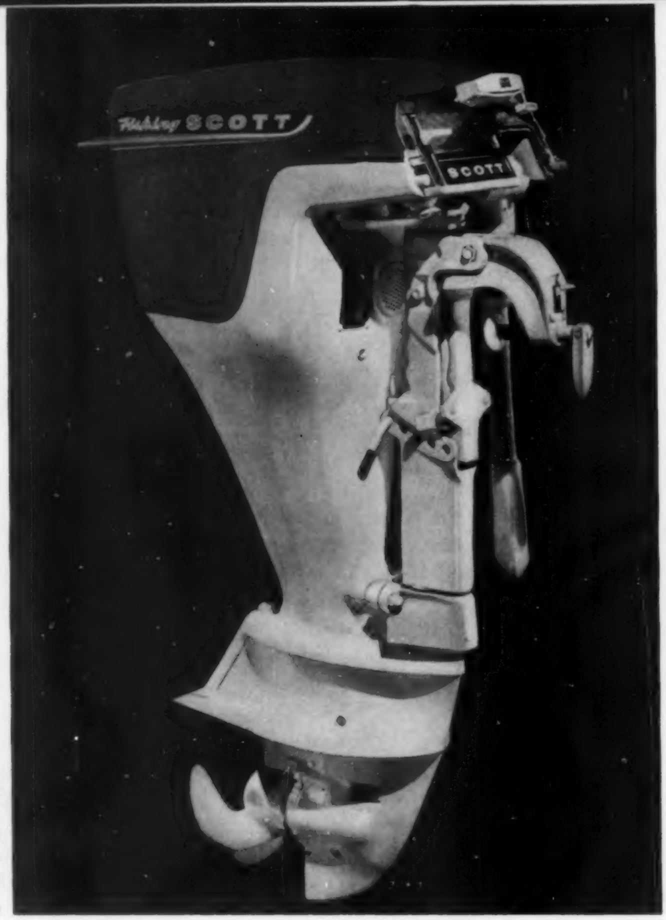
TWO-PIECE molding forms package for shoe polish; is also applicator and buffer.



HARD SURFACE increases water impermeability of styrene foam, making it applicable to such uses as floats and buoys. Cross-section of buoy illustrated shows molded-in channel for placement of hardware attachments.

For outboard motor housings . . .

INJECTION MOLDING CUTS COSTS



HOUSING of Scott outboard motor (colored area) is injection molded of impact acrylic, weighs 30 ounces. Quantity production run makes material-tooling-production costs competitive with previously used glass-reinforced polyester housing. Photo, Scott

The introduction of a line of outboard motors with hoods injection molded of impact acrylic underlines two things: 1) that once there is sufficient volume inherent in any market, high-speed injection molding combined with the right thermoplastic formulation can be counted on to move into competition with traditional materials, or even with other types of plastics and plastics processing techniques; and 2) that sport and pleasure boating has indeed become a mass consumer market in the U. S.

In the case of the outboard motors, the steady growth of the market has been responsible for two switches in materials by one company in recent years. The manufacturer of the motors, the Scott Div. of McCulloch Corp., Minneapolis, Minn., originally used die cast aluminum for its motor hoods. By 1957, volume had increased to the point where MODERN PLASTICS reported that a switch to glass-reinforced polyester—which offered equal or superior strength—had proved economical. Since 1957, reinforced plastics (RP) has become the dominant material for outboard hoods of most manufacturers.

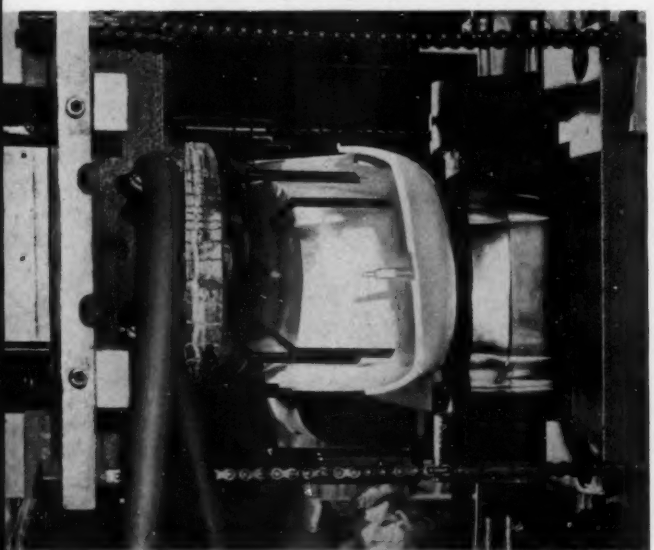
Now Scott is using an injection-molded impact acrylic hood on its 7½-hp. line—the "Fishing Scott"—designed especially for use by sport fishermen in trolling operations and heavy weed conditions. The hoods, molded of white material, weigh from 24 to 30 oz., wall thicknesses average 0.100 inches. Except for the company's 3.6-hp. motor—smallest in size and dollar volume—which employs a formed metal cover, all other Scott motors, which range up to 75.2 hp., still use molded RP hoods.

Why injection-molded impact acrylic?

Scott's decision to use injection-molded thermoplastic was based on two proven facts: 1) the availability of a material—impact acrylic—which would provide properties equal or superior to those of the RP hoods then in use, and 2) a production study which showed that, in the quantities contemplated, hoods could be produced more economically by injection molding.

In selecting impact acrylic for the hood material, Scott worked on the basis of extensive field tests which showed that: impact acrylic, in addition to having sufficient strength, was immune to discoloration from sunlight, resistant to damage from fuels and oils to which it would come in contact, and showed good resistance to abrasive scratches—important to any outdoor portable product. These tests were run first on flat sheets

MOLDED HOOD is ready for removal from press. Note interior gating, which is used to prevent marring of high-style smooth surface.



Photo, Sinko Mfg.

of the material, then on thermoformed prototype hoods that were tested in actual use.

Before turning to injection molding, Scott studies developed these figures: 1) injection molding tools for the hoods would cost $12,500 vs. $7,500 for RP compression molds, 2) but savings on material costs and a speedier production rate resulting from use of injection-molded thermoplastic design—for the number of hoods needed to meet marketing plans—would result in a per-hood price of approximately $1.60, compared to a price of $2.60 for the RP hood.

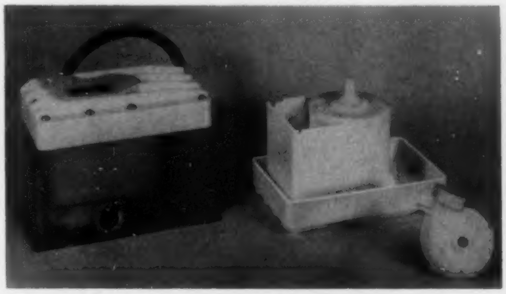
Because the impact acrylic material has proved itself for this application; and because injection-molded hoods for the 7½-hp. motors have proved themselves economical, Scott admits that it is studying the feasibility of extending this design to its larger motors. The principal consideration in whether this is done for any motor in its line will be the number of units to be produced vs. cost of the necessary molds. Once sales volume warrants it, Scott foresees no problem in injection-molding hoods for its largest motors.

Credits: Impact acrylic material (Implex A) supplied by Rohm & Haas Co. Hoods molded by Plastics Div., General American Transportation Corp., Chicago, Ill., and by Sinko Mfg. & Tool Co., Chicago—**End**

Other marine applications of impact acrylic—and why

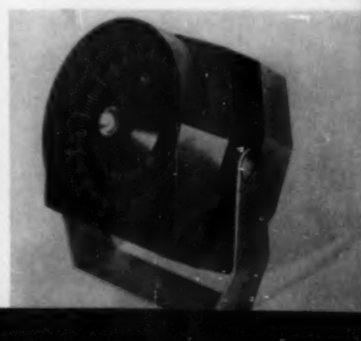
There are three basic reasons why high-impact acrylic is being specified for a growing number of marine and boating applications: 1) its properties, which combine rugged strength with resistance to salt water, oils, and greases; a high degree of dimensional stability; low moisture absorption; and its easy moldability to close tolerances for watertight sealings; 2) the cost savings of molded parts compared with aluminum or zinc die castings which they often replace; and 3) design flexibility and good surface finish—increasingly important in the growing marine consumer market.

Below are just three of many recent marine applications making use of the material.



BILGE PUMP: strength, chemical resistance, plus moldability to close tolerances, make high-impact acrylic a good choice for functional parts often made of zinc or brass.

WATER-SKIING INTERCOM: housings and screw-on bezels of two-speaker system are molded to close tolerances which, combined with low water absorption factor, make for water-tight, trouble-free operation. Unit at left is attached to skier's tow bar; one at right is hand held, used from aboard boat.



ELECTRONIC DEPTH INDICATOR: three parts of high-impact acrylic are used: back and front—including sun shade rim—of case and cemented-on dial face. Strength and moisture resistance assure protection of delicate electronic components of 8-in. device.

Photos, Rohm & Haas

BLOW-MOLDED TANKS for windshield washer fluid (top) and brake fluid (bottom, left) are made of low-pressure PE.

PVC CABLES are used for sparkplug wiring. Air hose of carburetor is made of polyurethane.

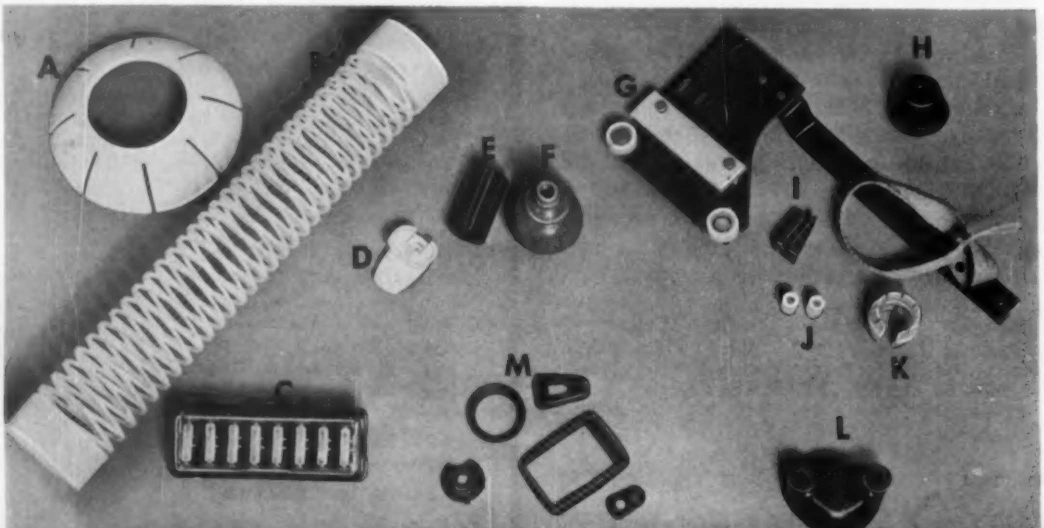
Annual use of 21½ million lb. in German compact car adds up to

26½ lb. of plastics in each VW

In a recent visit to Germany, the Editor of MODERN PLASTICS had an opportunity to visit the Volkswagen plant in Wolfsburg, West Germany. From the plastics standpoint, there was much of interest in the way of materials selection and use. As one of the pioneers in the revolutionary concept of the "compact car," Volkswagen engineers have relied heavily on plastics to give them the light weight, design flexibility, and economy they need. Management estimates are that 26½ lb. (12 kilos) are used per car, or over 21½ million lb. of plastics a year (900 tons a month).

Plasticized polyvinyl chloride accounts for about half of this consumption. The PVC goes into unsupported sheeting for upholstery, sliding-roof coverings, and for making carpet eyelets to distribute hot air. Other PVC sheeting backed up with urethane foam is used as covering for the door panels and seat side shields, sun visors, and instrument cluster. Extruded vinyl profiles and shapes provide trim for the running board, gasketing, welting, cable wrappings, and cable hose. And in a departure from American practice, many interior fittings, especially protruding parts such as coat hooks and handles, are molded of flexible PVC as a safety feature. **(To page 164)**

PARTS SHOWN use a range of resins: **A)** polypropylene shim used on cap between gear case and rear axle halves; **B)** polypropylene supporting cage for hot air pipe; **C)** polycarbonate fuse box; **D)** coat hook, **E)** insulation cap, **F)** gear shift knob—all PVC; **G)** mounting plate, **H)** carburetor float, **I)** lock part, **J)** rollers for sliding roof, **K)** seat-adjustment pins—all of nylon; **L)** dielectric distributor connection of polyethylene; and **M)** button and handle washers of polyethylene.



Selecting sheet for thermoforming

A guide to choosing the right type and gage of sheet for any application in terms of properties, cost, and processing investment

By A. L. Griff*

The success or failure of a thermoformed application—both in terms of function and cost—is more often than not directly related to the sound judgment shown in the original selection of a specific plastic sheet for the job. In light of the imposing number of formable sheet materials that are available today, choosing correctly can be a formidable and complex task—unless the manufacturer can adopt an impartial approach based on technical fact in making his decision.

It is the purpose of this article to present just such a 10-point approach that will help the thermoformer organize his selection process, avoid oversights, put his costing on a more realistic basis, and have more confidence in his decisions.

Here are eight questions the manufacturer, designer, or processor should ask himself when choosing a sheet material for thermoforming:

1. What is the application?

Basic though the question is, it is probably one of the easiest to overlook. Defining an application as "a toy" or "a container" is not enough. To select the right sheet material, the definition

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Table II. Typical properties of various thermoplastic sheet materials

Material	Impact Strength	Rigidity	Chemical Resistance[c]	Heat Resistance	Cold Resistance[d]	Bendability	Light Stability[e]	Gloss	Low Friction	Transparency	Self-extinguishing
Polyethylene (0.96 density)[a]	B	B	A*	B	A	B*	D	B	A	B	No
Polyethylene (0.95 density)[a]	B*	C*	A*	C*	A	A	D	B	A	B	No
Polyethylene (0.92 density)[a]	A	D*	A	C	A	A*	D	A	A	B*	No
Polypropylene	B	C*	A*	A	D	B	D	B	B*	B*	No
Unmodified polystyrene, GP	D	A*	B	B*	D	D	D*	A	B	A*	No
Unmodified PS, hi-heat	D	A*	B	A	D	D	D*	A	B	A*	No
Medium-impact PS, hi-heat	D*	A	B	B*	D	D*	D	C*	B	C*	No
Medium-impact PS, regular	D*	A	B	B	D*	D*	D	C*	B	C*	No
High-impact PS, hi-heat	C	A	B	B*	D*	C	D	C	B	C	No
High-impact PS, regular	C*	B*	B	B	C	C*	D	C	B	C	No
Super-impact polystyrene	A	B	B	B	A	A	D	D	C	D*	No
ABS polymers	A	A-C*	A	A-B	A	A	B	B	B-B*	D	No
Rigid PVC, hi-impact	A	A*	B	C	A	A*	B	B	B*	C	Yes
Rigid PVC, normal	D*	A*	A*	C*	D	D*	B*	B*	B*	A	Yes
Plasticized PVC[b]	A	D	B	D	A-D	A*	B-C	A-D	D	A-D	Many
Acrylics	D*	A*	B	A-B	C	C	A	A	—	A*	No
Cellulose acetate	B	A	C	C	C	A-B	A	A	—	A	No
Cellulose propionate	A-C	B-C*	C	B-C	C	A-B	B*	A	—	A	No
Cellulose acetate/butyrate	A-B	B	C	B-B*	C	A-B	A	A	—	A	No
Ethyl cellulose	A	B-C*	C	B-B*	A-C	A	B	A	—	A	No
Nylons	B	A-B	B*	A*	B*	A-B	B*	B	A*	C	Yes
Polyacetal	B	A	A	A	B*	A-B	B*	B	A*	C	No
Polycarbonates	A	B*	B	A*	A	A	B	A	—	A	Yes
Fluorine polymers	A	C*-B*	A**	A*	A	A	A*	A	A*	D	Yes

Grades: A = Excellent B = Good C = Fair D = Poor Grades with * = a little better than a grade without*

[a]Formulations are available at many intermediate densities. Also ethylene copolymers are available with properties in this range.

[b]Properties will vary because of the numerous possible formulations.

[c]General evaluation. See suppliers data for tests in specific environments.

[d]Impact-type resistance.

[e]For unstabilized materials. Addition of carbon-black or ultra-violet absorbers is a major improvement.

Table II: Worksheet for calculation of investment

1. Assume yearly requirements of *40 million* pieces.
2. Each piece weighs *0.10* pounds.
3. Therefore, annual poundage is *4 million* lb.
4. Assume work-week has *6* days.
5. Thermoformers run *3* shifts per day. (Extruders must run around the clock.)
6. Therefore, extruders run per year .... *7320* hr.
7. And thermoformers run per year .... *7320* hr.
8. Assume *75%* of sheet weight ends up in final product.
9. Assume *75%* of extrusion hours actually producing salable product.
10. Assume *80%* of thermoforming hours producing salable product.

Assume of the *20%* left that:

10a. *15%* is down time and

10b. *5%* is rejects

Items 9, 10, 10a, and 10b are the "safety factors" in the calculation which take into account downtime for maintenance, poor product made during startups, off-gage or off-color material, experimental time, etc.

11. Item 3, divided by Items (6 by 8 by 9 x [10 + 10 a]) is the actual required extruder capacity .... *1020* lb./hr.
12. Assume extrusion efficiency of *8* lb./hr. per hp.
13. Therefore, required power is ....*128* hp.
14. From knowledge of current extruder construction, decide whether these horsepower must be included in one machine, or divided among several. Space availability, nature of business, and available equipment are factors to consider. Also, consider sheet width required. A narrow sheet can be made on big or small machines, but a wide sheet (*e.g.*, 36 in. or more) needs a machine extruding at least 150 lb./hr., and preferably more, for best results.

    Number of machines *2*
15. Number of horsepower each .... *75* hp.
16. Output per machine .... *7500* lb./hr.
17. Barrel diameter and screw speed at normal use *4½* in. at *70* r.p.m.
18. From knowledge of forming technology and details of the part, assume the size of the unformed sheet as *24* in. by *36* in.
19. Expected cycle, which depends on the type of forming machinery used, the material used, and the part thickness and design, is estimated at *4800* parts per hour, per machine.
20. Item 1, divided by Item (7 by 10 by 19), yields the number of machines needed—which is approximately ......2 formers. Involved in Item 19 are the assumptions of
21. Parts produced per cycle *10*
22. Type of thermoformer *continuous in-line.*

COSTS

2	extruders, as above	$40,000
2	sheet dies	7,500
0	sheet take-offs	
0	shears and stackers, or else wind-ups	
2	thermoforming machines, as above	40,000
2	trimming machines	18,000

Costs of dryers, tumblers, blenders, granulators, heat sealers, as needed 20,000

Estimated costs of forming and trimming dies* 10,000

Material of forming molds *steel*

Number of molds per cycle *for 10 cartons*

Estimated installation cost 15,000

(The optimum sheet size and parts-per cycle can be determined by using this COSTS section, by trial and error, calculating total costs for each of several different sheet sizes). Note that takeoff and sheet die costs go down with decreased sheet size, while forming machinery costs go up.)

TOTAL INVESTMENT *140,500*

Investment per 100 lb./hr. capacity of finished part, for comparison to other production methods *25,700*

*This is considered operating cost, charged to the product cost, instead of initial investment. The next work sheet, Table III, handles it that way. It is included here only to help calculate parts per cycle.

should spell out such added data as the type of container, the type of product that will be put into it, the use to which it is put, etc. For example, if the container being considered will be used for hot drinks now, but might be used for cold drinks at a later date, the question to be put to the manufacturer is: does he want a compromise material *now* for both uses or would another material offering higher heat resistance at some sacrifice of other properties be preferable.

2. What properties are most important?

Once the definition of the application has been set, including the conditions to which the plastic article will be subjected, the user should then determine the properties he is after. He should realize the significance of each property so that he can assign it a relative value of importance.

In this way, the user will have a sound technical basis for choice; it will also serve as a guard against arbitrary choice. It is important, however, that the user know the exact requirements of the application in detail before he even tries to answer this question. For example, a firm wanting to make an all-plastic carton to package a particular product should first investigate filling machinery (How much impact strength or rigidity is needed?), the chemical nature of the product (What chemical properties are needed?), and the entire processing system (Is storage of "empties" a problem? What kind of handling do the cartons get?).

3. Which materials best fit the properties, independent of cost?

Once the manufacturer has set up the table of required properties, he can apply it against the properties chart shown in Table 1, p. 97. This is a good starting point; technical data available from suppliers will fill in the needed information. This approach insures that the best materials will first be selected for consideration, without financial prejudices—and then the all-important cost factor can be used to choose among them.

Let's take the carton again as an example. Suppose the important properties in this case are: bendability (resistance to cracking), maximum rigidity, serviceability from 0 to 70° C. at minimal load, ease of sealing, and inertness toward the contents. Referring to Table 1, the following might be selected on the basis of desired properties: 1) super-impact polystyrene; 2) 0.96-density polyethylene; and 3) polypropylene.

4. Is the part designed yet?

All too frequently, plastics are asked to do jobs designed for other materials—thus handi-

capping them in their competition with these materials. The further back in design stages that plastics are seriously considered, the better they will perform. Take the carton again as an example. Here, where general shape might be fixed by processing machinery, ribs can still be designed in a way that would be very difficult for a material such as paper. Someone familiar with the end-use, thermoforming techniques, and the materials should figure out the most desirable and economical design for each material.

5. Extrude the sheet or buy it?

Some criteria on which the end-user can base his decision follow.

Supporting experience. To do a good captive job, the end-user must have at his disposal experience in selection, testing, and engineering know-how in extrusion. If he doesn't have this experience, the costs of its acquisition and development may far outweigh the costs of sheet.

Timing. Paying for a competent extrusion staff while there are no orders is obviously wasteful. It is frequently desirable to buy sheet at first, at least until a new market develops, and then start to extrude sheet. Extrusion line deliveries are often as fast as 8 to 12 weeks, and can (and should) be sized to fit expected usage. (Buy equipment on a basis of pounds per hour to be processed, not on diameter of barrel.)

Labor. Extrusion is a 24-hr. operation, if it is to be economical. Many jobs can run five- or six-day weeks instead of seven, but few can shut down each night and still make money (unlike a thermoformer). If around-the-clock operation is already in practice, this will pose no problem.

Labor skills. Control of sheet thickness, maintenance of extrusion machinery, and operating tricks constitute valuable **(To page 166)**

Table III: Calculation of net cost per part

1. Amortization—machinery			
Machinery—total investment (without molds)	*$140,500*		
Assume *5* years to pay off investment.			
Cost per year	*$ 28,100*		
Parts per year (Item 1, Table II)	*40 million*		
Amortization per 100 parts	*$ 0.070*		
2. Processing costs (assume independent of material)			
Labor per year .... *8* men (all shifts)	*$ 50,000*		
Power to run machines, per year	*$ 5,000*		
Building overhead, including lights, heat, space, water, air, etc., per year	*$ 10,000*		
Estimated yearly equipment maintenance	*$ 10,000*		
Packing materials and labor, yearly	*$ 20,000*		
TOTAL this section	*$ 95,000*		
Parts per year	*40 million*		
Processing per 100 parts	*$ 0.238*		
3. Mold costs, yearly .... *$10,000*; figure replacement each 6 months.			
Mold costs per 100 parts	*$ 0.025*		
TOTAL "added value" per 100 parts	*$ 0.333*		
4. Material cost			
	Choice 1	Choice 2	Choice 3
Material	0.96 PE	Polypropylene	Super Impact PS
Sheet thickness mils	55	54	50
Pounds per 100 parts	10.2	9.43	10.0
Cost of material per pound (as of May 1961)	$0.35	0.42	0.35
Material cost per 100 parts	$3.57	3.96	3.50
ADD "added value," as above	0.33	0.33	0.33
Add costs of scrap handling, product and process development, sales, all other overhead distributed per year $60,000			
per 100 parts	*0.15*	*0.15*	*0.15*
TOTAL COST PER 100 PARTS	*$4.05*	*4.44*	*3.98*

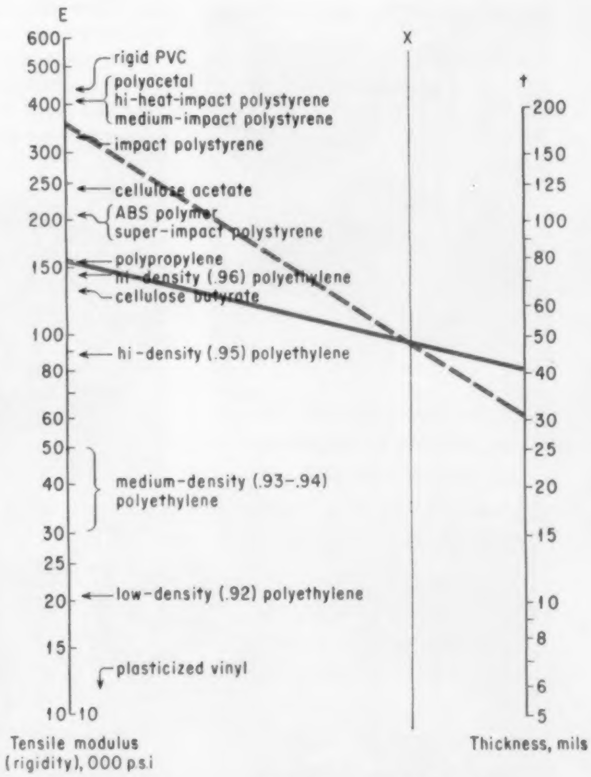
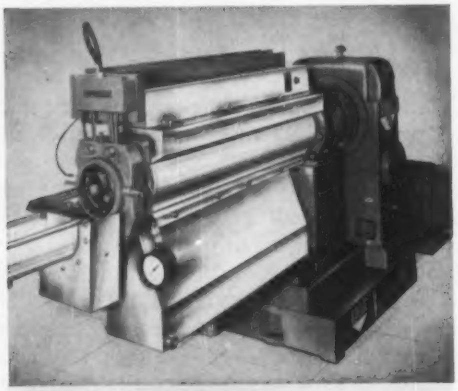


FIG. 1: Nomograph for calculating sheet thickness needed to achieve identical rigidity with change of plastics material. For example, if a material with a tensile modulus of 150,000 p.s.i. will do the job at 40 mils thickness, what thickness of a material with a modulus of 330,000 p.s.i. will be needed? To secure answer: draw a line (solid color) from 150,000 p.s.i. at Line E to 40-mil thickness, Line t. Then draw a line (dotted color) from 330,000 p.s.i. on Line E through the point where first line crossed reference line, X, to Line t. Point at which dotted line meets with Line t provides answer—in this case, 30 mils. Nomograph is based on formula: $Et^3/12 = \text{Constant}$.



#3 (3½″ bore) Royle Spirod Extruder showing section of retractable Cooling Tank.

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How to hot hob beryllium copper

Pressure casting extends the applicability of the hobbing techniques as a mold making method

By Islyn Thomas†

The availability of beryllium copper for plastic molds was first announced in the Fall of 1935 by the Gorham Co. For over two years prior to this announcement this company, in cooperation with the Beryllium Corp., producer of beryllium alloys and the owner of patents covering this application, had been conducting research and development to ascertain the practicability of beryllium copper molds and to work out a new technique of mold making for use in the plastics industry. In 1933, Alex Hamilton in Detroit also began employing this method for the production of forming jigs and dies.

In the 26 years which have followed this announcement, many things have been learned concerning this new material for molds. Early optimism has been tempered by the realization of certain limitations, and some early objections are being disproved as knowledge of methods of hot hobbing of beryllium copper increases.

For many years, there has been an unending quest for a material that would possess the thermal-conductivity and corrosion resistance of copper, coupled with the strength, hardness, and other desirable qualities of steel.

Beryllium copper, as it is known today, is the result of many years of research. With its exceptional strength, thermal-conductivity, and high resistance to wear, shock, fatigue, and tension impact, this material has opened the door to remarkable production innovations.

Beryllium copper, because of its unusual combination of intrinsic properties, can, with intelligent handling and sound application, give the utmost satisfaction to the discriminating user.

To appreciate the advantages of hot-hobbed beryllium copper molds it is necessary to mention briefly the metallurgical background of this alloy. As is well known, copper is a relatively soft metal, being hardenable in general commercial practice only by cold working, and then only to a moderate degree. In 1926 German investigators at Siemens & Halske found that small additions of beryllium, at that time a rare metal, made copper

*Reg. U.S. Pat. Off.

†**Islyn Thomas** started in the plastics industry in 1930 with Consolidated Molded Products Corp., leaving as Chief Engineer in 1942. He served as General Manager of Ideal Novelty & Toy Co. for 3½ years, and was an instructor of Advanced Plastics Engineering at Brooklyn Polytechnic Institute. He is now an international consultant to the plastics industry, with offices at 286 Kings Rd., Madison, N. J., having resigned as president of Newark Die Co.

Mr. Thomas is one of the founders of the Newark Section of the S.P.E. He served as National President of the Society in 1951. He was on the Board of Directors of S.P.I. for a number of years, and, from 1956 to 1959, was the National Chairman of the Mold Makers' Division. He is the author of "Injection Molding of Plastics," and many technical articles.

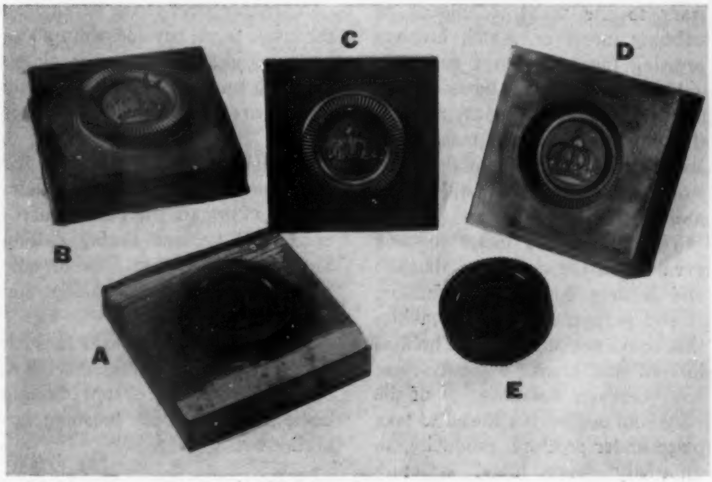

FIG. 1: Steps in the production of a hot-hobbed beryllium copper mold. Clockwise **A)** master pattern to make mold for cast steel hob; **B)** steel hob after casting; **C)** finished steel hob; **D)** beryllium copper hobbing; **E)** part produced in beryllium copper mold.

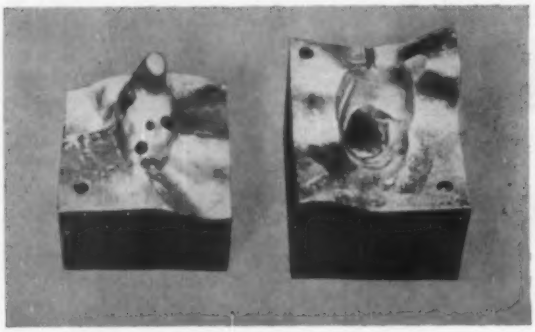

FIG. 2: Beryllium copper mold with irregular parting line. Hot hobbing technique allows perfect match of parting line.

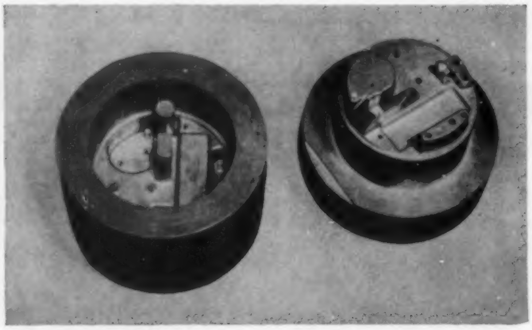

FIG. 3: Hot-hobbed beryllium copper cavity, showing raised pins cast into the mold. Such raised pins would be difficult to raise in steel cavities.

temperable by heat treatment to remarkably high physical properties for a non-ferrous alloy. It was discovered that beryllium copper chisels could readily cut a slice off steel boiler plate; springs of this new alloy would considerably outlast steel springs under conditions of corrosion and fatigue. A truly temperable copper alloy had at last been found.

Most shops producing hot hobbed cavities and cores generally maintain closed doors. This is necessary, not because they are afraid of disclosing any trade secrets regarding their techniques, but to protect the confidential nature of customers' work that is in the process of being done.

Hot hobbing is generally considered to be the best method as far as quality and accuracy of the finished mold is concerned. Contrary to the usual techniques of hobbing, however, which involves pressing the hob into a relatively cold blank of metal, these cavities and cores are produced by pouring the alloy around a steel master hob and then immediately applying pressure while the alloy is still in the molten state.

This allows the metal to flow evenly into the details of the hob and assures fidelity of definition. It also permits hobbing of cavities that could not otherwise be hobbed in cold steel blanks without severe hob breakage. Solidification of the beryllium copper is allowed to take place under pressure, producing an unusually dense metal structure with good impact and compressive strength and a smooth surface. Accurate reproduction of intricate detail, thin sections, irregular parting lines, as well as raised letters or numbers can be obtained by using this method.

Hot hobbing equipment

The following equipment is required for hot hobbing of beryllium copper.

1. Melting furnace capable of bringing metal to 2000° F.
2. An annealing or soaking furnace having temperature control with a precision of at least ±10 up to 1500° F.
3. A preheat oven which has a range from 350 to 1200° F.
4. A two-speed hydraulic press of at least 200 tons capacity with a downward ram movement of at least 1 in. travel in 5 seconds. The bottom platen should be stationary.
5. A roller track conveyor or crane extending from the soaking furnace to the press bed.
6. Heavy steel chase beveled on the inside faces, beveled shim plates and various sizes of pusher plates.
7. An acetylene torch for carbon filming or "smoking" of the master hob.
8. Master hob of the part for which the mold is to be made; machined or cast from an air hardened steel because during casting and hobbing the hob must be able to withstand simultaneous heat and pressure.
9. Various machine tools such as drill presses, milling machines, sand blasting and vapor honing equipment, for mold finishing operations.

Hob design

A very important part of the tools and equipment necessary for the hot hobbing of beryllium copper is the hob—the master form with which the correct shape is impressed in the cavity.

The hardened steel hob, as can be seen in Fig. 1C, p. 101, is a replica of the article to be molded.

While the design practice for hobs will vary from one shop to another, there are some fundamental rules of hob design which should be observed. These include the incorporation of as many fillets as possible, elimination of sharp corners, the use of maximum permissible taper or draft (minimum of 1½ degrees on all working surfaces), highly polished surfaces, and no undercuts.

Air hardening steel is usually selected for the hob because of its good machining characteristics, minimum shrinkage on hardening, depth of hardness, compression strength, and the combination of substantial hardness with toughness. The hob must be able to withstand heat and pressure. Hobs are generally machined from a steel block, but some are cast from steel.

Cast steel hobs made by the Shaw process, a new casting technique, which is now proving itself to be most economical and practical. The cast hob (see Fig. 1B) is produced in a new type ceramic mold which imparts many highly desirable characteristics including dimensional accuracy, surface smoothness, and freedom from sand or glass inclusion.

Since the Shaw process is a casting technique, a pattern or model (Fig. 1A) of the finished article is required. Almost any solid material can be used for the model, but preferably a soft metal such as aluminum or brass, which can be ac-

curately machined and highly polished. When dimensional accuracy is not as important, plastic, clay, or wood may be used.

The models or patterns for the cast steel hobs should be made slightly oversize, generally about 2% to allow for the contraction of the steel when cooling. The master steel hob should be hardened from 55 to 58 on the Rockwell C Scale and polished.

One must bear in mind that the shrinkage of the beryllium hobbed cavities upon cooling averages about 0.004 in./in. in cooling from the pouring temperature to room temperature. Therefore, the master hob should be made large enough to compensate for this shrinkage.

When a single-cavity mold is being made, it is quite possible and economical to anneal the steel hob after the hobbing operation and further machine so it may be used as the core of the mold. This provides a perfect mold parting line match without machining, which is particularly advantageous where the parting lines are irregular. Fig. 2, p. 102, is an example of a mold made in this way.

One recent advance in beryllium hobbing technique that might well be brought out at this point is that of making an extra hobbed beryllium cavity so it may be used as a hob for the mold core. This is sometimes referred to as reverse hobbing. On flat parting lines, wall thickness is removed from the face of this extra female hob, thus automatically providing an adjustment for wall thickness on the top of all cores which are then produced from this female hob. Using this technique, stock removal is required from the sides only. On irregular parting lines machining the parting line faces is not feasible. However, we have the advantage of a matched parting line on all of the cores. This core forming the inside of the part may then be machined to allow for correct wall thickness of the part. One important caution must be considered. Since the master female hob continues to shrink with each core hobbing, one hob should be provided for each three cores at the most, where wall thickness or shut-off areas are critical. An over depth of 1/32 to 1/16 in. on hobs with a flat parting line is advisable to aid in

Table I: Mechanical properties of Berylco 275C casting alloy

	Conditions			
Properties	*As cast* *min.*	*Cast and H. T.* *min.*	*Sol. ann. and W. Q.*[a] *max.*	*Sol. ann. W. Q. and H. T.*[b] *min.*
Heat treatment				
Time, hr.	—	2	—	3
Temperature, °F.	—	650	—	650
Tensile strength, 1000 p.s.i.	90	95	75	150
Yield strength, 0.2%				
Offset, 1000 p.s.i.	50	55	30	110
Elongation, % in 2 in.	16	16	5	0
Rockwell hardness				
B Scale	80	90	90	—
C Scale	—	—	—	42
Electrical conductivity				
% IACS	15	16	10	15

[a] Solution annealed and water quenched. [b] Solution annealed, water quenched, and heat treated.

economical fitting. A groove 1/32 in. deep and 1/16 in. wide or more around the shut off line of the hob contour on irregular parting lines will provide a bead that is much easier for bluing-in.

Any shut-offs, cored holes, or bosses machined into the hob will be reproduced on each and every core, free. The same reasoning applies to the regular, initial hob.

Core pins in beryllium cavities with diameters as small as 0.093 in. and over ½ in. high have been hobbed. Fig. 3, p. 102, shows a cavity with hobbed mold pins.

Mold alloys

There are many beryllium copper alloys available, but the best results have been obtained from the high-strength Berylco 275C. This formulation, which is manufactured by the Beryllium Corp., Reading, Pa., consists of the following composition:

Beryllium	2.6 to 2.85%
Cobalt	0.35 to 0.65%
Copper	
Balance (approx. 96.75%)	

Berylco 275C is a special-purpose foundry material designed for hot hobbing (pressure-cast) dies for plastic molding and other applications which require castability, strength, hardness, and wear resistance to a high degree.

Table I, above, lists typical physical constants for this alloy, while Table II, right, gives average mechanical properties.

The casting alloy is supplied as ingots for remelt and pouring without change in chemical composition. Ingot sizes are 5 lb., 2½ lb. and 3 ounces.

As received by the customer, casting alloy ingots present no health problem. In the normal sequence of events, hazard first arises when any of these beryllium products are melted and fumes are released. Other typical sources of hazardous fumes and dusts are the removal of gates and risers, flash grinding, machining, welding, and brazing. Drosses generated during processing require cautious handling as they contain particles which readily become airborne.

In short, any operation which produces a particle small enough to enter the lung during inhalation requires application of good industrial hygiene practice. This will be nothing new to the many foundrymen accustomed to the

Table II: Physical properties of Berylco 275C

Specific gravity	8.09
Density, lb./cu. in.	0.292
Melting range, °F.	1570 to 1660
Thermal expansion coefficient:	
20 to 100° C.	0.0000166[a]
20 to 200° C.	0.0000170[a]
20 to 300° C.	0.0000176[a]
68 to 212° F.	0.0000092[b]
68 to 392° F.	0.0000094[b]
68 to 572° F.	0.0000098[b]
Thermal conductivity:	
B.t.u./sq. ft./in./hr./°F.[c]	600 to 750
Elastic modulus in tension, p.s.i.	19,000,000

[a] in./in./°C. [b] in./in./°F. [c] At 68° F.

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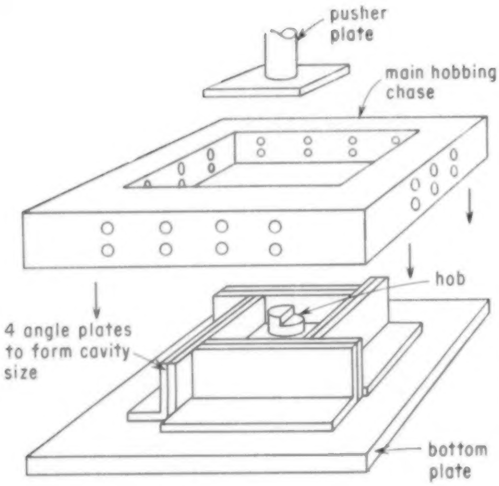

FIG. 4: Hot hobbing assembly. After close clamps sides of hob to form sides of mold casting, pusher plate exerts pressure on molten beryllium, which is poured over the hob.

proper handling of brass, lead, manganese, nickel, and other casting materials capable of producing occupational respiratory ailments. With beryllium the same basic control is applicable. The only difference is one of degree in that beryllium has lower limits of permissible atmospheric concentration.

The extent to which hoods, air exhaust systems and other industrial hygiene measures are needed, is best determined by applying the accepted yardsticks of air contamination to actual conditions.

Melting and pouring

Beryllium copper alloys are readily melted in electric, gas, oil, or coke-fired furnaces. Electric furnaces of the arc or induction types provide rapid heating, as well as good temperature and quality control. In using coke, gas, or oil-fired furnaces, care should be exercised to prevent the pick-up of combustion products.

For best results, each heat should be of known quality and composition. Virgin metal is generally used together with clean foundry scrap, such as gates and risers. To insure conformance with published properties, care should be taken to restrict impurities to a minimum. This can best be accomplished by making sure that beryllium copper scrap used in melting is not contaminated by other metals and that crucibles are clean. Some loss of beryllium can be expected in remelting scrap. Oxidation losses of beryllium should not exceed 0.1 percent. Stirring should be avoided, since it tends to increase beryllium loss.

Fluxes or slag covers are not needed, but dry charcoal covers are recommended when using a rocking arc furnace. Since beryllium itself is a deoxidizer, deoxidants are not required. The proper control of melting and pouring temperatures is important. Superheating of beryllium copper alloys is not advisable.

When the proper pouring temperature is reached, the charge should be poured immediately—not held in the furnace. Metal should be poured through as short a distance as possible with minimum turbulence. During melting, beryllium copper tends to form less dross than the usual nonferrous alloys. Any problem with dross formation is best remedied by close control during melting, although dross may also be formed by excessive agitation of the molten metal in the mold or by sands of high moisture content. Although inverse segregation is the rule, this defect is not pronounced. Other defects and their remedies follow usual bronze foundry practice.

Safety precautions required for handling molten beryllium copper in the foundry are similar to those generally used in handling bronze.

Hobbing procedure

The actual mechanics of the hobbing operation are simple and easy to describe since the only movement necessary is forcing molten metal over the master hob which has been set in a chase and moved on to the stationary platen of the hobbing press. However, considerable experience is necessary before the sort of cavity demanded by the industry today can be produced with guaranteed consistency.

The following outline briefly covers the required steps in producing hot-hobbed cavities made from beryllium copper.

First, the hob is examined carefully for roughage, porosity, undercuts, or cracks, since many of these faults in the hob will cause the hobbed cavity to rip when hob is removed. The hob is then cleaned with a hard bristle brush.

After cleaning, the hob is thoroughly covered with a parting agent to facilitate its separation from the hobbing. A commonly used parting agent is carbon soot, which is "smoked" onto the hob using an acetylene torch.

The hob assembly of shim

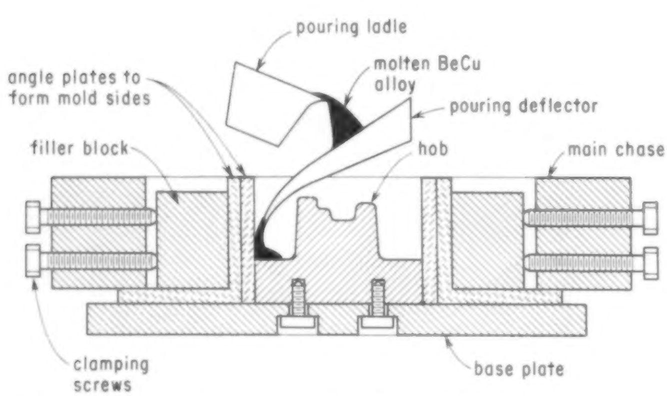

FIG. 5: Cutaway view of the hobbing chamber, showing technique to be used in pouring the mold. A deflector plate is used to keep molten metal from impinging directly on the hob.

Table III: Turning speeds, feeds

Cut	Feed	Speed, r.p.m. — High speed steel tools: Range	Starting	Carbide tipped tools: Range	Starting
in.	in./min.				
$\frac{3}{16}$ to $\frac{3}{8}$	0.015 to 0.030	50 to 100	75	125 to 175	200
$\frac{1}{16}$ to $\frac{3}{16}$	0.010 to 0.020	75 to 125	100	150 to 350	250
$\frac{1}{64}$ to $\frac{1}{16}$	0.008 to 0.012	100 to 200	150	200 to 400	300
0.007 to $\frac{1}{64}$	0.002 to 0.008	100 to 300	225	300 to 600	450

plates, top pusher plate, and "smoked" hob is then put into a soaking furnace and brought up to approximately 1150° F., while the beryllium copper is being melted.

An ample quantity of beryllium copper is melted as quickly as possible. No flux or cover is necessary for melt under 50 pounds. Over 50 lb., it is desirable to melt under crumbled dry charcoal.

The hot hob and plate assembly is then removed from the soaking furnace by means of a roller conveyor, and the master chase lowered into place around the hob assembly and the combination moved directly on to the hydraulic press platen (see Fig. 4, p. 106).

The metal is then poured in the range of 2000° F. over the hob, the pusher plate is inserted in the chase over the molten metal, and hob and hydraulic pressure applied to the assembly as quickly as possible. The time interval, between the first molten metal into the chase and the application of the maximum pressure used, is most critical, since the metal touching the hob and the sides of the chase will freeze rapidly. When pouring, a stainless steel deflector or scoop is used to direct flow of molten metal away from the hob and against side wall of chase to prevent splashing (Fig. 5, p. 106).

As a general rule a pressure of 2000 p.s.i. will result in a good hot-hobbed cavity or core, but the specific pressure to be used for a job will depend on the size and shape of the hob. A large hob with sturdy, heavy sections can take up to 10,000 p.s.i., whereas a hob with thin fins and sections must be pressed lightly or the thin section of the hob will move and distort the cavity.

After the hobbing has solidified and partially cooled, the whole assembly is removed from the press and the heavy chase raised. The shim or side plates are then tapped away from the hob, hobbing, and pusher plate. The pusher plate is then knocked off, and the hob is removed from the beryllium copper hobbing before the assembly becomes too cold. If the hob and hobbing become too cold it will be necessary to reheat them to approximately 1000° F. before they can be separated.

Finishing

Although they are not free-machining materials, Berylco casting alloys can be readily handled with the proper tools, cutting fluids, speeds, and feeds using techniques similar to those used in machining non-leaded tin, silicon, or aluminum bronze. High strength beryllium copper alloys (Berylco 20C and 275C) should be machined prior to hardening. If parts are annealed after hobbing, it is generally advisable to machine them in the solution-annealed condition.

Tools and cutting rates. High-speed steel tools will give good service for heavy and intermittent cuts at moderate speeds, while carbide tools offer higher production rates over long runs. For best results, hobbings or castings should be machined with high speeds, light feeds, and a moderate cut. Since beryllium copper alloys work-harden rapidly, the depth of the cut should always be great enough to get under the work-hardened layer. With standard high-speed steel tools, the speeds and feeds shown in Tables 3 and 4, above and below, can be used for castings in either the "as cast" or solution-annealed condition.

Cutting fluids. Soluble oil emulsions should be used as a cutting fluid when heat removal is of primary importance. Mineral lard oils have added lubrication values. Sulfurized mineral lard oils provide the best combination for lubrication, penetration, and surface finishing. They will stain the casting, however, unless they are removed immediately after the machining operation.

Removing gates and risers. Band or hack saws, as well as abrasive

Table IV: Milling speeds and feeds for heat-treatable beryllium copper

		Depth of cut, in. — Over $\frac{1}{8}$	$\frac{1}{16}$ to $\frac{1}{8}$	Under $\frac{1}{16}$
Speeds, ft. per min.				
Tool material	High-speed steel	100 to 150	150 to 200	200 to 300
	Carbide	200 to 400	300 to 600	500 to 900
Feeds, in. per tooth				
Type of cutter	Plain helical mill	0.010 to 0.015	0.015 to 0.020	0.008 to 0.012
	Side mill	0.012 to 0.025	0.016 to 0.030	0.008 to 0.015
	Face mill	0.012 to 0.025	0.016 to 0.030	0.008 to 0.015
	Staggered-tooth mill	0.008 to 0.014	0.014 to 0.018	0.006 to 0.010
	End mill	0.007 to 0.012	0.010 to 0.015	0.005 to 0.010

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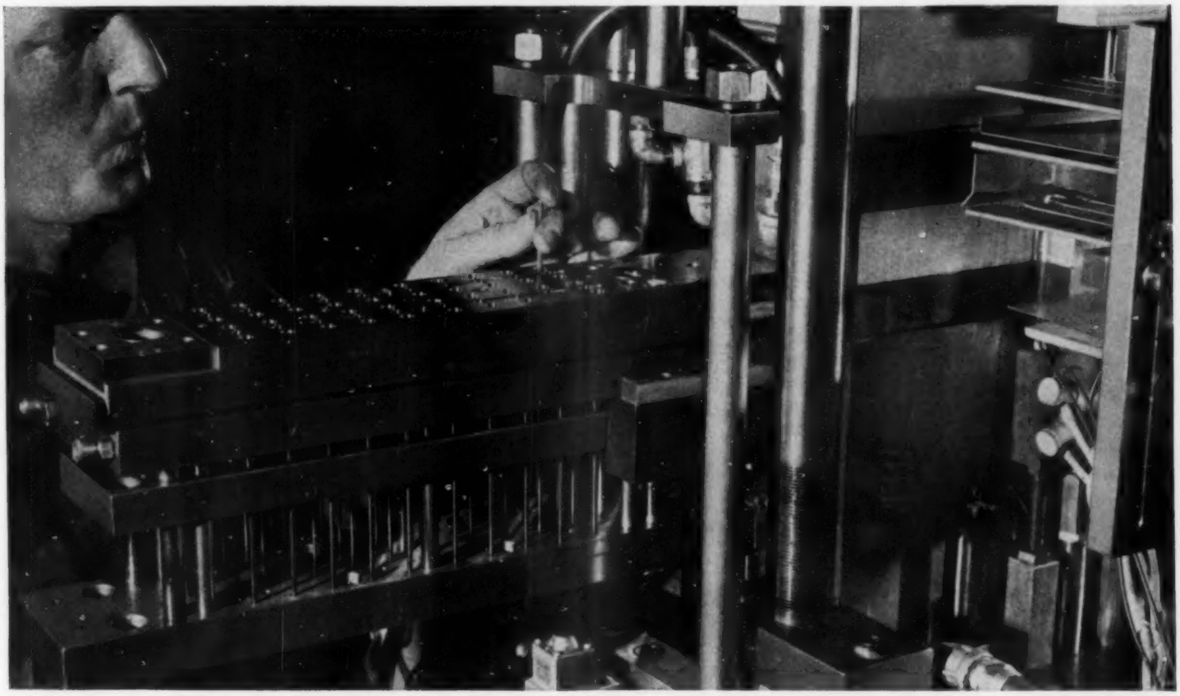

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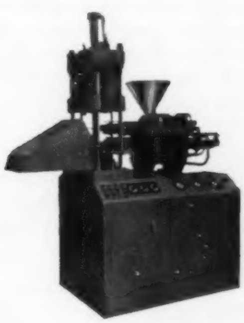

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cut-off wheels, are used for removing gates and risers. Saw teeth should be well spaced to provide adequate chip clearance and prevent packing. Rough grinding, including snagging or cutting-off, generally precedes hardening.

Joining. Beryllium copper hobbings or castings can be joined or repaired satisfactorily by soft soldering; silver brazing; carbon, metal or inert-arc and resistance welding. Except for soft soldering, all joining operations precede heat treating.

Repair methods. Cracked or defective castings can be readily repaired by carbon-arc or Heliarc welding. These methods can also be used to build up worn surfaces. Although aluminum and silicon-bronze electrodes may be used for repair welding, only beryllium copper rods deposit weld material with properties approaching those of the base metal.

Heat treating

Although moderate properties can be obtained in castings or hobbings by heat treating from the "as cast" condition, maximum properties are obtainable only through the 2-step operation of solution annealing as well as precipitation hardening.

Castings or hobbings of Berylco 275CR should be solution annealed at temperatures between 1475 to 1500° F. depending on the size of the casting. Any type of furnace that permits adequate temperature control is suitable. Castings are immediately water quenched after being removed from the furnace. It is suggested that salt baths should not be used, since most salts rapidly attack the surface of beryllium copper at the annealing temperature.

The hardening or aging treatment can be carried out in a muffle or circulating air furnace. Close control of temperature is important. Variation should be small (±10° F.) and heating should be uniform throughout the furnace. If there is considerable temperature variation from point to point within the furnace, variations in hardening response can be expected. Salt baths are not recommended, since the irregular shape of castings may make cleaning difficult. Recommended age-hardening treatment for Berylco 275CR is 3 hr. at 650° F.

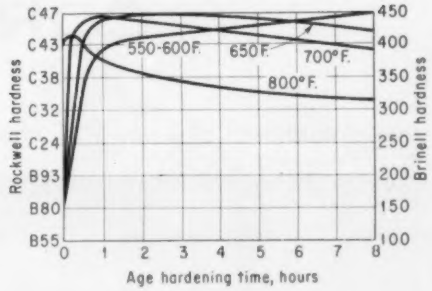


FIG. 6: Effect of age hardening time and temperature on the hardness of cast and solutions annealed beryllium copper. (Berylco 275C).

This treatment produces the highest degree of strength and hardness. Fig. 6, above, shows the effect of aging time and temperature on hardness. After aging, castings or hobbings can be cooled at any convenient rate to room temperature.

The age-hardening feature of beryllium copper offers design advantages not available in casting alloys that do not respond to heat treatment. By varying hardening times, temperatures and quenching mediums, different combinations of properties can be obtained. Overaging, for instance, gives higher thermal conductivity and added impact strength, with some loss of tensile strength and hardness.

Where maximum strength is not required, the solution-annealing treatment can sometimes be eliminated. The "cast and heat-treated" condition saves time as well as money since fewer operations are performed.

For applications requiring a bright finish for appearance, or where subsequent operations require a clean surface, the oxide film caused by heating in an uncontrolled atmosphere furnace can be removed by pickling, liquid honing, or sand blasting.

Surface finishing

Beryllium copper hobbings or castings can be readily cleaned, polished, or buffed in the same manner as other copper-base alloys, using suitable standard equipment as well as techniques. Sand blasting, liquid honing, or shot blasting eliminate the necessity for pickling and, with or without buffing, often provide the final finish for many castings.

Surface scale formed on castings during annealing and hardening can be removed by the following pickling procedure.

Immerse the casting in 20% sulfuric acid solution heated to a temperature of 160 to 180° F. for 15 to 30 min. to completely loosen dark scale.

Then rinse the casting thoroughly in cold water.

After rinsing, bright dip in 25% cold nitric acid solution for 15 to 30 sec. to remove all traces of red scale. To prevent etching the metal, immersion time is best determined by trial.

Finally, rinse throughly in hot water and dry.

To get a thorough cleaning job, oil, grease, and dirt must be completely removed before pickling. After pickling, acid must be completely removed from the hobbings or castings, and the castings must be thoroughly dried in order to prevent staining.

Plating. Standard plating and coloring treatments may be applied to the cavities or cores. Parts must first be thoroughly cleaned, and a polished surface is necessary to obtain the best results. For resistance to corrosion from phenolic or vinyl plastics or rubber, beryllium copper hobbings are usually given a flash chrome plate 0.3 to 0.6 mils thick. Chrome plated beryllium copper has long life because the plating wears uniformly and is not likely to develop pin holes.

Maintenance and storage of beryllium copper cavities require no special consideration. Since the alloy resists corrosion, it is not necessary to lubricate the surfaces to prevent rust. However, as with any precision molds, the molds should be stored carefully to prevent accidental mechanical damage or abuse.

One of the **(To page 174)**

CORRUGATING RIGID

The development of a new PVC compound and new extrusion equipment provides the answer to the production of a new building material

By Garland A. Nisbet* and W. G. Potts**

A joint development program that was carried out by the National Rubber Machinery Co. and the B. F. Goodrich Chemical Co. has resulted in the development of a new extrusion technique and a new vinyl compound which makes possible the continuous production of corrugated, unplasticized, rigid vinyl sheet.

Although the method of post-forming continuously rigid vinyl sheet into corrugated sheeting is in use in Europe and Japan, the two firms above are the first in this country to develop a technique which promises to make available to builders corrugated rigid vinyl sheet for industrial glazing partitions, roofing, etc. at a cost competitive with other types of corrugated sheeting such as that made from fibrous glass-reinforced polyester resin.

The rigid vinyl material used to make the sheeting in the new process is Geon 82304. This is a vinyl compound developed specifically to have the extrusion and forming characteristics required by the process combined with the weathering, flexural strength, fire resistance, and impact strength required in proposed building applications.

Along with the new material, new equipment was also required. As a result of the machine development program, a special extrusion die was designed that makes it possible to produce a rigid vinyl sheet on a continuous basis with a trimmed width of 48 in. and with good control of the sheet thickness or gage. In addition to the sheet extrusion die, a post-forming die was also developed to impart the corrugations to the sheet as it is extruded from the die. Special attention was paid to the design of the post-forming die in order to make certain that stresses would not be induced in the sheet that was being corrugated.

Equipment

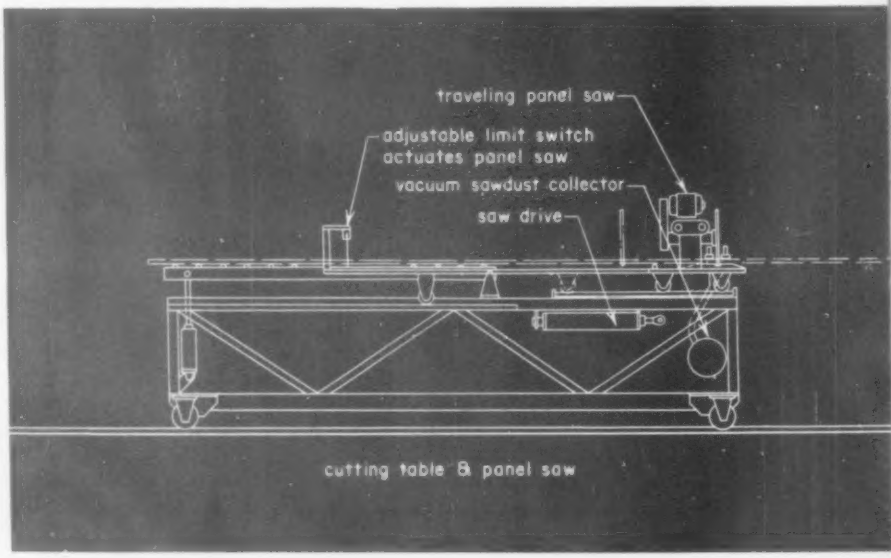
Figures 1 and 2, right and below, are a photo and drawing of the corrugated sheet production line, respectively. The equipment shown is that on which the process development work was done. The extruder used was a 3½-in. NRM "Pacemaker" equipped with induction heating and a liquid cooling system. Other types of heating are satisfactory but the use of induction heating combined with liquid cooling lends itself to rapid heat-up and excellent control of extrusion temperature because of its rapid compensation of frictional heat buildup within the material as it is sheared in the extruder.

Although a 3½-in. extruder was used in the development work, a 4½-in. extruder is recommended for maximum production. With a 4½-in. machine, rates of about 250 to 300 lb./hr. can be expected. This is equivalent to the production of 600 to 700 sq. ft./hr. of corrugated sheet, 0.060 in. thick.

The screw to be used for the extrusion of the rigid vinyl sheet should have a compression ratio of 1.7:1 and a L/D ratio of 20:1. It should also have a constant taper with decreasing root depth and no metering section. The pitch of the screw should equal the flight diameter. The recommended front flight depths of the screw to be used for various size extruders are:

2½-in. extruder	0.200 in.
3½-in. extruder	0.300 in.
4½-in. extruder	0.375 in.

Fig. 3, p. 114, is a closeup of post-forming die and shows the intermeshing forming teeth in the open position. After the sheet being extruded is fed through the



*Development Group Leader, B. F. Goodrich Chemical Co., Cleveland, Ohio
**Assistant Sales Manager, Extruder Div., National Rubber Machinery Co., Akron, Ohio.

PVC SHEET

FIG. 1: Developmental corrugated sheet extrusion line. Extrusion die and corrugation forming die are at right center of the picture. Special multiple wheel pull-off is shown at right.

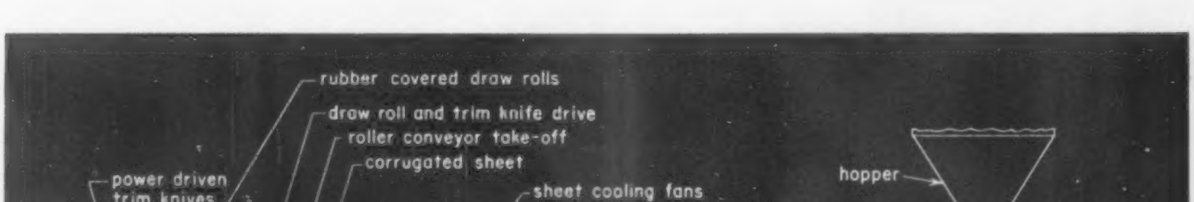


FIG. 2: Relative positions of the equipment for the extrusion and forming of corrugated rigid vinyl sheet.

Physical properties of Geon 82304 green translucent rigid vinyl

Property	*Value*	*ASTM test no.*
Specific gravity	1.37 + 0.02	D792
Tensile strength, p.s.i.	7500	D638
Flexural strength, p.s.i.	15,000	D650
Compressive strength, p.s.i.	9400	D695
Tensile modulus of elasticity, p.s.i.	410,000	D638
Hardness, Durometer D scale	80 + 3	D785
Izod impact strength, ft.lb./in. notch at 78° F.	1.7	D265
Coefficient of linear expansion, in./in./°F.	3.9×10^{-5}	D696
Thermal conductivity, B.t.u./sq. ft./hr./°F./in.	1.3	C177
Dielectric strength, volts/mil	1080	D140
Heat distortion temperature at 264 p.s.i., °F.	160	D686
Flame resistance	Self-extinguishing	D635

forming die, the die is "closed," thus inducing the corrugations in the sheet as it moves through the die. The die is adjusted by means of air cylinders so that the spacing between intermeshing portions of the forming die are in accordance with the thickness of the sheet being formed. The die is so constructed that its interior coring (provided for temperature control) does not interfere with the removal of the corrugating teeth in the die when a change in the corrugation cross-section is desired. Thus, the corrugated design in the sheet may be changed with a minimum of cost and lost production time. Many shapes can be made by the insertion of the proper forming die segments. Decorative panel designs, either regular or variegated, and many shapes of uniform thickness, can be formed with a minimum of expenditure for tooling. In addition, less time is required to make this type of die operable than that required for a regular extrusion die.

FIG. 3: Close-up of sheet-forming die showing corrugating teeth which intermesh when the die is in operation. Teeth are "T" slotted to fit on "T" bar, thus allowing easy changes of teeth when corrugation pattern is to be changed. Air cylinder at right controls closing of the die.

The post-forming die is placed as close to the sheeting die as is possible. In this way, the forming of the sheet is done at a high temperature, before it has a chance to cool. Thus a minimum of strains are created which could cause the sheet to distort in service as the "extruded-in" strains relax. Tests made on the formed sheet produced in this way indicate that no relaxation had taken place in the corrugated sheeting after a 24-hr. exposure to a temperature of 160° F.

Operation of equipment

When corrugating the sheet, the forming die temperature is held at about 80° F. At this temperature, the sheet slides easily through the die. The speed of the sheet take-up rolls is maintained as closely as possible to the linear output of the extruder. This is done to prevent differentials in web speed and the introduction of strains in the direction of sheet flow.

During extrusion, the barrel temperature is set so that temperatures range from 300° F. at the rear of the extruder barrel to 340° F. at the front, or die end, of the extruder; temperature is raised in equal increments of 10 or 20° F. in each heater zone. The extruder head temperature is set at 330° F. and a die temperature of 350° F. should be used so that the exit stock temperature runs between 350 and 360° F.

In setting up the corrugated sheet production line, the following procedure is recommended: (See Fig. 1)

1. The process temperatures are set as described above. Sufficient time should be allowed for uniform heating of the die.

2. The lips of the extrusion die are adjusted to produce the required thickness of sheet.

3. The choker bar in the extrusion die, just behind the die lips, is set in the open position.

4. When the extrudate begins coming out of the die, the choker bar is lowered and adjusted until a uniform and smooth sheet results.

5. The sheet is then passed through the open jaws of the forming die and put through the take-off rolls.

6. The forming die is closed on the sheet and the take-off speed is adjusted to pull the sheet through the die. This speed is set as close to the linear output of the sheeting die as possible.

7. Trim cutters are adjusted to the width of sheet desired. Trim and scrap are sent back for regranulation and reprocessing.

8. An automatic, travelling cut-off saw is set to cut the desired lengths of corrugated sheeting.

The physical properties of Geon 82304 Green Translucent material are shown in the table above. In addition to the properties shown, the compound has low moisture sensitivity, good resistance to dirt pick-up, good chemical resistance, and exhibits no surface erosion.

Although data on the outdoor aging of this material is not as yet complete, accelerated tests in the WeatherOmeter are encouraging. Corrugated rigid vinyl sheet made of similar compounds in Europe has been in outdoor service for four years. A recent examination of such sheet installation showed no deterioration in color or properties. The material will be available in a variety of colors, both translucent and opaque. The sheet is expected to find its major use in industrial construction.—**End**

Automated system doubles production rate of RP preforms

Use of a specially designed preformer and oven combination doubles the production rate of fibrous glass preforms

By A. G. Trivison*

The principle of the familiar revolving door has been applied to the new Sly fibrous glass preformer and curing oven that was installed at Plastic Products Corp., Bedford Heights, Ohio.

The unit is used in the preforming and pre-curing of fibrous glass and acrylic binder into basic shapes that will later be combined with plastic resin and molded into finished products. Typical items custom-molded by the company include laundry tubs, flower boxes, chemical tanks, toboggans, and snow coasters.

With the previous method for making preforms, two skilled operators with two sets of application and curing equipment were required for the same production now achieved by one skilled operator and one unskilled helper.

In the old method, a skilled operator applied the shredded fibrous glass and binder on the preform screen at one work area. He then carried the entire unit to a box oven and set it inside for curing at 325° F. Total curing time averaged 2 min., with a maximum of 3 min. for the largest preforms. After curing, the preform was removed and the screen had to be carried back to the first operation. This was repeated continuously through the day. The screens in themselves weigh as much as 15 lb. each, and the preforms as much as 2 lb. or more—quite a **(To page 176)**

*Mgr., Oven Sales, The W. W. Sly Mfg. Co., Cleveland, Ohio.

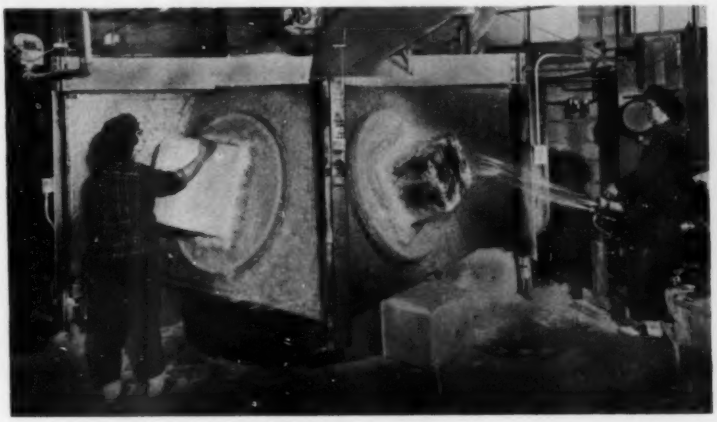


FIG. 1: Fibrous-glass preformer showing the application and unloading stations. As mix is applied, circular table holding metal preform screen rotates to insure uniform application of fibrous glass-binder mixture.

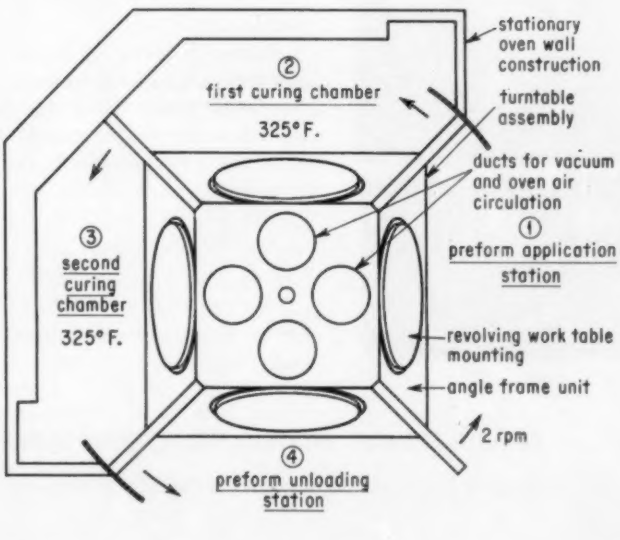
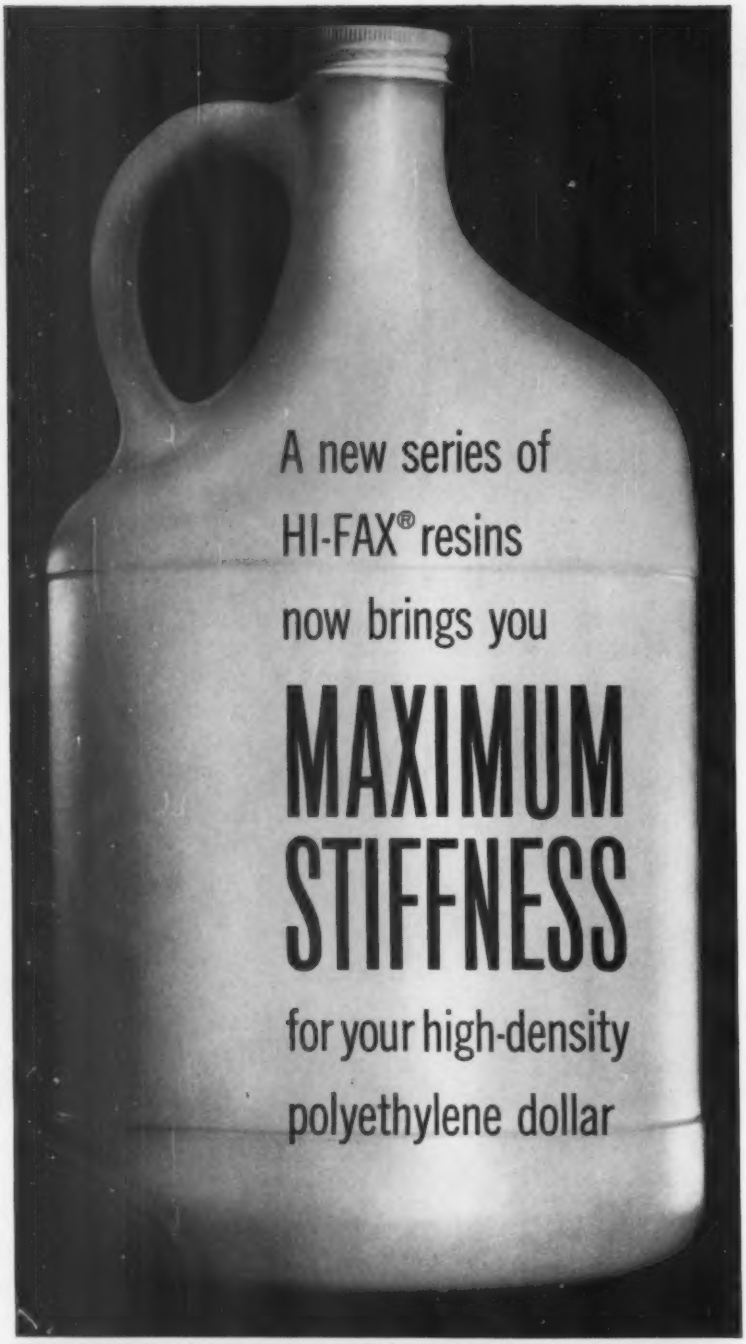


FIG. 2: Plan view of the preformer showing the rotating station turntable. Stations rotate about central axis.



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CP61-9

Ignition temperatures of plastics

By Guy A. Patten†

The hot-air ignition furnace, developed by N. P. Setchkin of the National Bureau of Standards, provides the means of determining the lowest practical ambient temperature at which a material will ignite in an optimum supply of air. Plastics can be ranked according to ignition susceptibility; thus actual use hazard can be assessed.

Penetration of plastics into the construction, appliance, cushioning, and textile fields has focused attention on flammability. It is generally recognized that various plastics, once ignited and burning, exhibit widely differing rates of surface flame spread, smoke evolution, and heat release. Several tests are available for evaluating each of these factors, and efforts are being made to correlate test results with actual burning behavior.

A comprehensive consideration of the total hazard of a material in a given application must also include a study of initial resistance to ignition under various exposure conditions as well as behavior during burning. In the past, attempts to define the ignition characteristics of a material have included immersion in baths of molten salts and metals, exposure to heated rods, a study of ignition time-lag on exposure to elevated temperatures, and measurement of the specimen surface temperature at the time of ignition. The results obtained by these methods were difficult, if not impossible, to correlate with behavior under typical end-use conditions. Ignition test temperatures were often several hundred degrees higher than the lowest ambient air temperature capable of causing ignition of a material in an actual application.

The air temperature causing ignition of a specimen is a far more meaningful measure of ignition susceptibility than the temperature of the specimen surface or of a superheated igniting agent. When a plastic is exposed to a variety of exposure conditions, the actual ambient temperature capable of causing ignition becomes a prime safety consideration. A combustible material will ignite when the atmosphere reaches a temperature high enough to start a self-sustaining exothermic oxidation of the specimen by the available oxygen.

A method and device designed around this simple principle, described by Setchkin(1)[1], provided a means of determining the lowest possible temperature of ambient air, supplied at an optimum rate, that would ultimately cause the specimen to ignite. This approach realistically approximates hazardous exposure conditions in actual use. Two ignition temperatures are of interest: flash-ignition and self-ignition. These temperatures are synonymous to the "flash point" and "ignition temperature" values of the open and closed cup methods for oils. Minimum ignition temperatures are indicated by the temperature of uniformly heated air passing across the specimen at an optimum rate at which flash- or self-ignition occurs.

Setchkin defined flash- and self-ignition temperatures as follows:

Flash ignition temperature. The lowest initial temperature of air passing around the specimen at which sufficient combustible gas is evolved to be ignited by a small external pilot flame.

Self-ignition temperature. The lowest initial temperature of air passing around the specimen at which, in the absence of an ignition source, ignition occurs of itself, as indicated by an explosion, flame, or sustained glow.

Apparatus

The ignition furnace (2), Fig. 1, p. 120, consists of two vertical, concentric, ceramic tubes 8½ to 10 in. long and 4 and 3 in. in inside diameter, respectively. The outer tube is heated by electric current passing through 50 turns of No. 16 B & S gage nichrome wire wound around the tube and covered with alundum cement. The outer tube is covered with 3 in. or more of glass wool insulation. The outer metal surface of the furnace thus measures approximately 10 in. in diameter and 9½ in. in height, excluding the legs. The inner concentric tube is mounted approximately 1 in. above the floor of the furnace on three spacer blocks. Metered air is admitted tangentially near the top of the annular space between the concentric tubes and is heated as it passes downward. Uniformly heated air enters the

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†Plastics Technical Service, The Dow Chemical Co.

[1]Numbers in parentheses refer to references at end of article, p. 180.

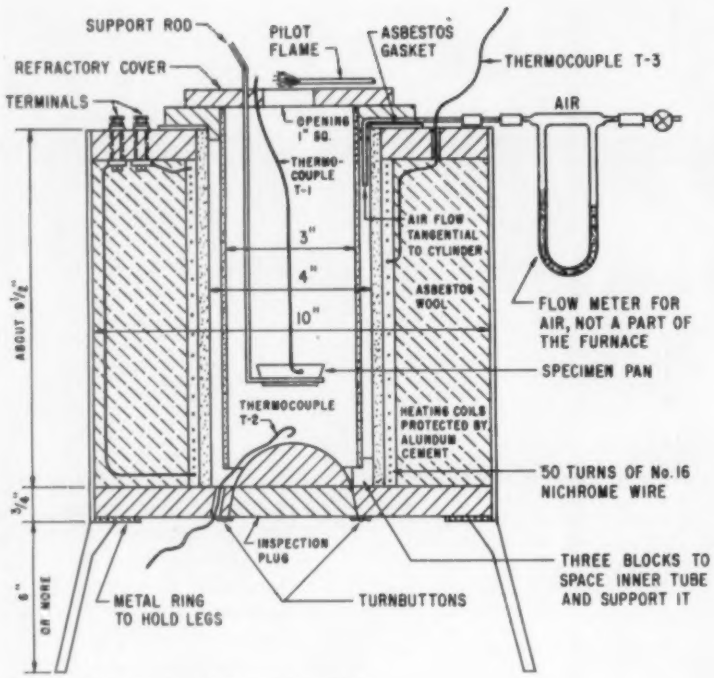

FIG. 1: Cross-section of furnace assembly.

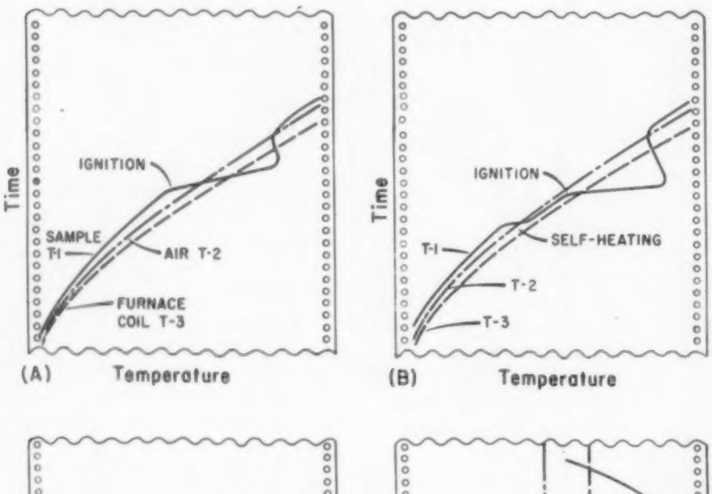

FIG. 2: Characteristic ignition curves as plotted on recorder chart paper. **(A)**—ignition without self-heating; **(B)**—ignition with self-heating; **(C)**—glowing ignition; and **(D)**—constant temperature method for determination of minimum ignition temperatures.

inner furnace tube at the bottom, passes upward around the specimen, and leaves the furnace through an opening at the top.

Three thermocouples are used to measure test conditions. T_1 is located at the upper surface of the test specimen; T_2 is located in the air space beneath the specimen; T_3 is attached to the alundum surface over the heating coils.

The specimen, weighing approximately 3 g., is placed in a container measuring 1½ in. in diameter and ½ in. in depth. The entire assembly (container, specimen, and thermocouple T_1) is suspended within the inner tube 7½ in. from the top of the furnace by a 1/16-in.-diameter metal rod.

Experimental procedure

The test procedure, described in detail later, consists essentially of first determining the optimum air-flow rate for minimum flash- and self-ignition temperatures by a series of rising temperature tests made at 600° C./hr. rise. An excessively high air-flow rate may either cool the specimen during self-heating or dilute the evolved vapors, thus retarding ignition at the lowest possible temperature. The same effect may be noted if the air-flow rate is so slow that the atmosphere surrounding the specimen becomes fouled and insufficient oxygen is present for permitting easy ignition.

An approximation of the ignition temperature range is next obtained by conducting rising temperature tests at a rate of 300° C./hr. The minimum ignition temperatures are then determined at constant air temperature at the previously determined optimum air-flow rate. The minimum constant air temperature causing eventual ignition of the test material is reported as either flash- or self-ignition temperature, as defined previously, depending on the presence or absence of an external pilot flame above the furnace opening.

Characteristic curves

Characteristic ignition temperature curves as plotted on recorder chart paper are shown in Fig. 2, left. Figure 2A shows a material (polystyrene, for example) that ignites without preliminary self-heating during the rising tem-

Table: Ignition temperatures of plastics and other materials (4)

Material	*Flash-ignition temp.*	*Self-ignition temp.*
	°*F.*	°*F.*
Polystyrene	680	925
Polyethylene	645	660
Ethyl cellulose	555	565
Polyamide (nylon)	790	795
Polyester—glass fiber laminate	750	905
Styrene-acrylonitrile	690	850
Styrene-methyl methacrylate	625	905
Polyvinyl chloride	735	850
Polyvinylidene chloride	>990	>990
Urethane foam (rigid polyether)	590	780
Polystyrene beads	565	915
Polystyrene beadboard	655	915
White pine (shavings)	500	500
Paper newsprint (cuts)	445	445
Cotton (batting)	490	490

perature runs. Conversely, Fig. 2B shows a material (such as polyethylene) that goes through a prolonged period of self-heating before ignition occurs. Occasional materials, as shown in Fig. 2C, do not ignite into flame, but exhibit a sustained glow.

Figure 2D is of special interest because it is the constant temperature tests that ultimately determine minimum ignition temperatures. Materials that do not self-heat during the rising temperature conditions often do so under constant temperature conditions. Certain materials exhibit both flash- and self-ignition points during constant temperature tests, but not during rising temperature tests.

The final step in determining the minimum ignition temperature is illustrated in Fig. 2D. The furnace is adjusted to give an air temperature at the approximate level found in the rising temperature runs and with the optimum rate of air flow. The air temperature is recorded by the specimen thermocouple T_1 before admission of the specimen. Thermocouple T_2 records air temperature at the bottom of the furnace, merely to indicate constant furnace conditions. The original temperature of air resulting in ignition of the specimen represents the lowest possible ignition temperature. Thermocouple T_3 near the heating coils is used for furnace control.

Admission of the specimen to the furnace causes an initial drop in temperature T_1, which then reapproaches the original value as the material heats. If self-heating occurs, specimen temperature T_1 eventually surpasses air temperature T_2 and when ignition occurs, may briefly rise above coil temperature T_3. After combustion is complete, T_1 slowly falls to the original constant temperature value. Additional runs are made at successively lower temperatures until ignition fails to occur. Flash- and self-ignition determinations are similar, except the pilot flame. Materials giving off generous quantities of volatile gases usually flash-ignite well below the self-ignition temperature. If volatiles are scant, the material self-ignites, even when the pilot flame is present; flash- and self-ignition temperatures are equal.

If a material fails to ignite below 750° C. (1382° F.) at an air flow rate of 10 ft./min., it is defined as "noncombustible" by ASTM Method E 136-58T (3). This method employs the same ignition furnace herein described; thus it is possible to obtain ignition temperature ratings or a noncombustibility rating (depending on the material) by appropriate use of the two techniques.

The table shown above presents flash- and self-ignition temperatures for several plastics, as well as for wood, paper, and cotton. It is significant that plastics have relatively high ignition temperatures. Accidental ignition from heat sources such as incandescent bulbs, steam lines, molten tar, etc. would be virtually impossible for all practical purposes. Materials can be ranked in order of susceptibility to ignition and can be evaluated by this method as to relative ignition hazard in actual use when in the same state of subdivision.

The ignition temperature technique described is under investigation by ASTM Committee D-20 on Plastics for possible adoption as an ASTM standard method.

Recommended test procedure

A. First approximation of flash-ignition temperature (effect of air-flow rate).

1. Low air-flow determination.

a. Place specimen in furnace.

b. Set air flow at 5 ft./min.

c. Adjust variac controlling current to furnace coils to provide a rapid rise in temperature (T_2) of approximately 600° C./hr. (±10%).

d. Light gas pilot and place across hole in top of furnace.

e. Note the air temperature (T_2) at which the combustible gases are ignited. This point is evidenced by a rapid rise in the specimen temperature (T_1). This is an approximation of the flash point.

2. Medium air-flow determination: Repeat A-1 with an air setting of 10 ft./min.

3. High air-flow determination: Repeat A-1 with an air-flow setting at 20 ft./min.

Note 1: At all times the air-flow is adjusted to actual rate through full section of inner tube. An air-flow rate within ±10% of the stated value is suitable. Air-flow rate may not be critical for some materials. If so, this should be noted in the report when listing "air-flow rate used."

B. First approximation of self-ignition temperature (effect of air-flow rate).

1. Repeat A-1, a, b, and c, without pilot.

2. Repeat A-2, a, b, and c, without pilot.

3. Repeat A-3, a, b, and c, without pilot.

Note the recorded air temperature (T_2) at which the specimen flames, explodes, or glows.

C. Second approximation of flash-ignition temperature. Choose air-flow setting **(To page 180)**

Cast flexible urethane polymers

By C. H. Smith* and C. A. Peterson**

An investigation was undertaken to determine the effect of molecular structure on physical and electrical properties of polyester-based cast urethane polymers. The polyesters were prepared from adipic acid and various short chain diols. These polyesters were then converted to isocyanate-terminated prepolymers through reaction with three commercially available aromatic diisocyanates. The prepolymers were reacted with anhydrous 1,4-butanediol to form cast urethane products, whose physical and electrical properties were determined. The correlation between structure and properties is discussed.

In recent years several companies in this country have placed both millable and castable flexible urethane polymers on the market. Due to their ease of fabrication into complex shapes, the cast variety is of particular interest. However, most of these materials are of a proprietary nature so that little, if any, correlation can be drawn between their composition and physical properties.

This investigation was undertaken to obtain this type of information. The first step was the preparation of several adipic acid based, hydroxyl rich, linear polyesters. Various diols were used in the synthesis. The polyesters were then reacted with various diisocyanates to form isocyanate-terminated prepolymers. Polymer chain extension was achieved using 1,4-butanediol which gave the 0.5-hr. or longer pot life needed for casting, along with relatively low temperature curing. Hindered amine extenders were found to be much too reactive with this type of cast polymer.

The formulated liquid materials were cast into 6 by 6 by 0.125 in. open-face molds and cured in forced draft ovens. Test buttons 0.5 in. in diameter were also prepared in open-face molds. Physical and electrical properties of the cured materials were determined.

Preparation of polyesters

Both the adipic acid and glycols were used as received from the manufacturer. The diols for the most part were designated as urethane grade and the acid as polyester grade. A calculated amount of reactants was used in each preparation to produce a polyester of 50 to 70 hydroxyl number. Since these materials are basically dihydroxy compounds, this would mean the polyester would have a molecular weight of about 2000.

A typical polyester preparation using adipic acid and diethylene glycol was as follows: A 2-liter resin reaction flask, heated by means of an electric mantle, was fitted with a stirrer, jacketed thermocouple, Dean-Stark water trap, and a nitrogen inlet tube. A water-cooled reflux condenser was mounted above the water trap. The flask was charged with 963 g. (6.6 moles) of adipic acid and 806 g. (7.45 moles) of diethylene glycol. A total of 50 ml. of toluene was added through the reflux condenser, filling the water trap and overflowing into the reaction flask. The toluene was used for azeotropic distillation of water, produced during the course of the reaction. Both the water and toluene were collected in the trap, with the toluene being returned to the flask and the water withdrawn and measured.

The temperature was raised rapidly and as soon as the reactants became molten the stirrer was started. The reaction began at about 310 to 330° F. and after a time lapse of 2 to 3 hr., the reaction temperature reached 450° F. The reaction mixture was maintained at this temperature by means of a Pyro-O-Vane controller until an acid number of 6 to 8 was reached. The reactants were then raised to a temperature of 475° F. and held until an acid number of 3 to 4 had been obtained. Reduction of the acid number of the polyester to the desired range of 1 to 2 usually re-

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**Plastics Div., Butler Mfg. Co., Kansas City, Mo.

Table I: Properties of the polyesters

Polyester	*Diol*	*Hydroxyl no.*	*Acid no.*	*Moisture*	*Viscosity at 25°C.*
				%	cp.
1	2-Ethyl-2-butyl-1,3-propanediol	54.6	2.36	0.09	6,000
2	Diethylene glycol	55.2	3.74	0.03	8,500
3	Triethylene glycol	112	1.52	0.13	1,500
4	1,4-Butanediol	67.8	0.48	0.03	100,000 (crystalline)
5	2,2-Diethyl-1,3-propanediol	75	0.32	0.07	4,000
6	1,5-Pentanediol (70%) Diethylene glycol (30%)	61.7	1.33	0.05	3,875
7	1,4-Butanediol (70%) Diethylene glycol (30%)	50	2.93	0.06	7,400
8	1,5-Pentanediol (50%) Diethylene glycol (50%)	62.4	0.4	0.05	4,700
9	1,4-Butanediol (50%) Diethylene glycol (50%)	56.4	0.74	0.08	5,800

Table II: Properties of the prepolymers prepared with toluene diisocyanate (TDI)

Prepolymer	Polyester	Amine equivalent	Viscosity at 25° C.
			cp.
B	Polydiethylene glycol adipate	622	26,500
C[a]	Polydiethylene glycol adipate	594	30,000
D[b]	Polydiethylene glycol adipate	782	83,000
G	Polytriethylene glycol adipate	707	32,500
I	Poly-1,4-butanediol adipate	602	100,000
K	Poly-1,5-pentanediol (70%)/ diethylene glycol (30%) adipate	617	17,000
M	Poly-1,4-butanediol (70%)/ diethylene glycol (30%) adipate	600	25,000
O	Poly-1,5-pentanediol (50%)/ diethylene glycol (50%) adipate	653	11,500
P	Poly-1,4-butanediol (50%)/ diethylene glycol (50%) adipate	653	20,000

[a]50/50 ratio of TDI and diphenylmethane diisocyanate.
[b]50/50 ratio of TDI and dimethyldiphenyl diisocyanate.

Table III: Properties of the prepolymers prepared with diaromatic diisocyanates

Prepolymer	Polyester	Amine equivalent	Viscosity at 25° C.
			cp.
A	Poly-2-ethyl-2-butyl-1,3-propanediol adipate	631	100,000
E[a]	Polydiethylene glycol adipate	670	100,000
F	Polydiethylene glycol adipate	670	68,300
H	Polytriethylene glycol adipate	733	78,500
J	Poly-2-2-diethyl-1,3-propanediol adipate	700	100,000
L	Poly-1,5-pentanediol (70%)/ diethylene glycol (30%) adipate	649	57,500
N	Poly-1,-4-butanediol (70%)/ diethylene glycol (30%) adipate	738	66,500

[a]Made with dimethyldiphenyl diisocyanate; the other polymers were made with diphenylmethane diisocyanate.

quired heating at a temperature of 500° F. for a short period of time. Throughout the entire cycle nitrogen was sparged through the reactants.

Polyesters containing low-molecular-weight diols often required an esterification catalyst such as litharge in order to react them to the desired acid number.

Table I, p. 125, shows the various diols and combinations of diols used in the preparation of the adipates, along with the hydroxyl numbers, acid numbers, water contents, and viscosities of typical finished polyesters.

Preparation of prepolymers

Because of their low water content, the polyesters were reacted directly with the diisocyanates without drying. A reactant ratio of 3 NCO groups to 1 OH group was used for the prepolymer preparation. The preparation of prepolymers from solid diisocyanates required heating the diisocyanate to a temperature above its melting point before adding the polyester. The preparation of a typical prepolymer was carried out as follows: 261 g. (1.5 moles) of toluene diisocyanate and 1 g. of benzoyl chloride were charged into a 2-liter resin reaction flask, fitted with a stirrer, nitrogen inlet tube, jacketed thermocouple, and reflux condenser. The benzoyl chloride was used to maintain the pH of the reaction mixture below 7 during the

Table IV: Physical properties of cast urethane polymers

	Prepolymer[a]															
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Diisocyanate[b]	2	1	1,2	1,3	3	2	1	2	1	2	1	2	1	2	1	1
Hardness, Shore A	67	49	55	67	96	76	47	59	48	—	45	86	40	85	53	47
Compression set, %	84	16	61	65	60	78	52	91	32	91	53	62	45	68	35	21
Tear resistance, lb./in.	—	79	118	142	583	461	110	285	148	239	48	378	65	544	77	76
Tensile strength, p.s.i.	1633	257	563	640	2130	2095	410	1825	2278	1930	362	3750	497	2953	910	517
Ultimate elongation, %	383	267	560	420	710	837	433	517	567	481	697	617	793	763	873	607
Low temperature brittle point, °F.	—	−49	−43	−31	−5	−56	−58	−85	−85	−40	−100	−112	−100	−72	−100	−100

[a]See Tables II and III for composition.
[b]Code to diisocyanates: 1) toluene diisocyanate; 2) diphenylmethane diisocyanate; 3) dimethyldiphenyl diisocyanate.

course of the preparation. Slowly, over a period of 1 to 2 hr., 1015 g. of 55.2 hydroxyl number, adipic acid-diethylene glycol polyester was added. The reaction flask was then fitted with an electric heating mantle, and the temperature of the reactants was raised to 125° F. and held there for 1 hour. As was the case with the polyester preparation, nitrogen was sparged through the reactants.

Prepolymers were prepared from three commercially available diisocyanates: 1) toluene diisocyanate (65/35 mixture of 2,4 and 2,6 isomers), 2) diphenylmethane diisocyanate, and 3) dimethyldiphenyl diisocyanate. Table II, p. 126, shows the base polyesters, amine equivalents, and viscosities for the toluene diisocyanate prepolymers, while Table III, p. 126, demonstrates basically the same information for the diaromatic diisocyanate materials.

Preparation of cured polymers

Sufficient anhydrous 1,4-butanediol was added to a weighed amount of prepolymer so that 90 to 95% of the NCO groups present would be consumed. The mixture was blended by hand mixing with a spatula and then thoroughly stirred by means of an air-driven stirrer. In some cases the prepolymer was heated to 200 to 220° F. to facilitate mixing. The mixture of prepolymer and **(To page 181)**

Table V: Electrical properties of cast urethane polymers

Prepolymer	*Insulation resistance*	*Volume resistivity*	*Surface resistivity*	*Dielectric strength*
	megohms	*megohms/cm.*	*megohms*	*v./mil*
A	1.3×10^5	1.4×10^5	9.0×10^6	395
B	4.5×10^4	4.3×10^{10}	5.0×10^6	365
C	4.8×10^5	7.6×10^5	3.5×10^7	378
D	3.3×10^4	3.4×10^5	5.9×10^5	353
E	——	——	——	——
F	3.4×10^4	2.6×10^4	2.0×10^7	383
G	1.2×10^5	9.8×10^4	8.9×10^5	300
H	2.0×10^7	7.0×10^{11}	1.9×10^8	430
I	1.0×10^5	1.4×10^{11}	8.8×10^6	370
J	6.0×10^6	2.1×10^7	5.0×10^8	410
K	8.0×10^4	1.7×10^5	2.8×10^6	310
L	1.3×10^4	4.5×10^3	——	320
M	3.7×10^4	4.4×10^4	1.8×10^7	285
N	3.6×10^4	3.6×10^4	3.4×10^6	300
O	1.7×10^5	3.0×10^5	2.4×10^7	395
P	1.0×10^5	9.9×10^4	2.8×10^7	385

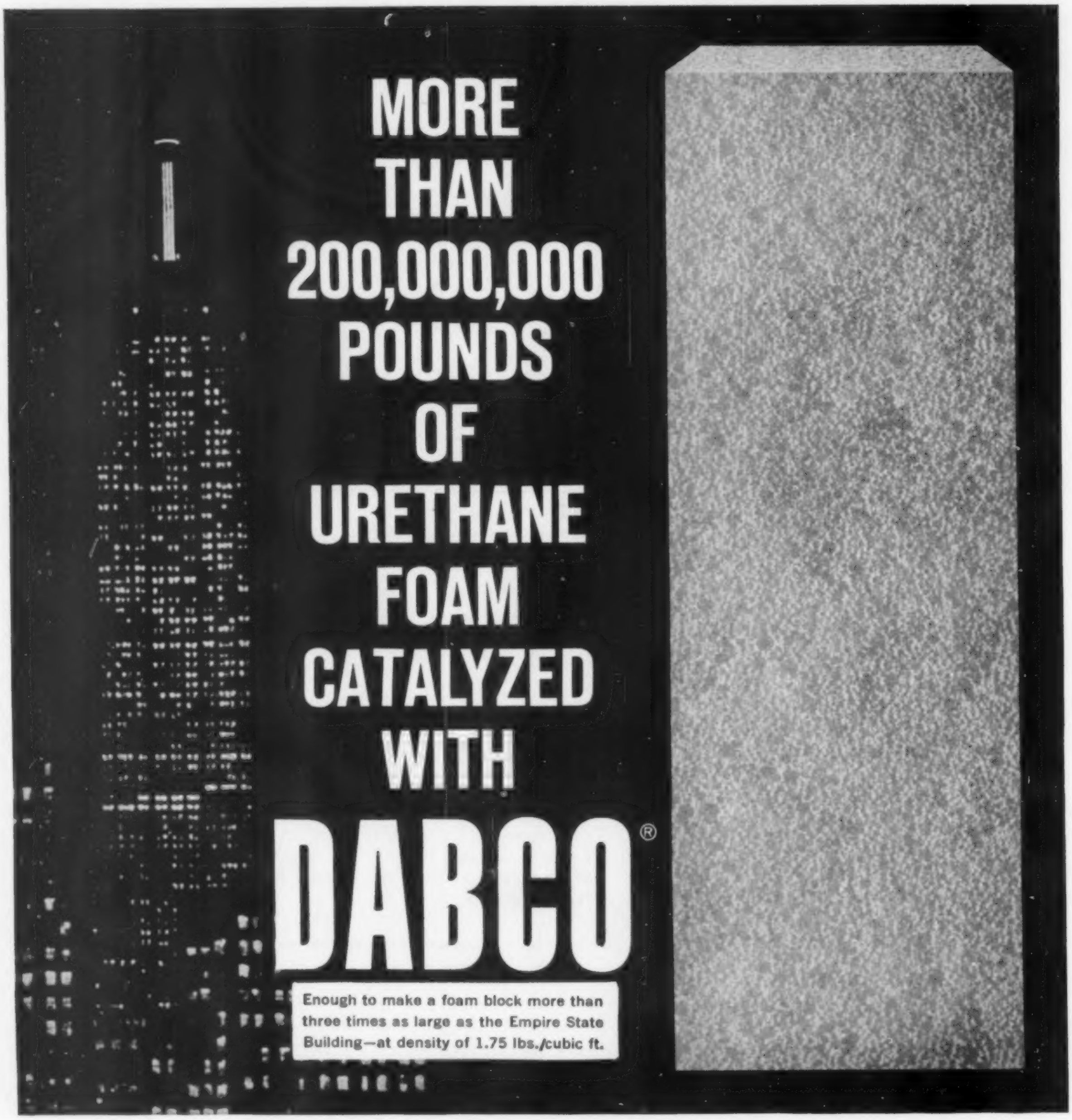
Table VI: Physical properties of polyurethanes made with adipic acid-diethylene glycol polyesters

Pre polymer	*Diisocyanate*	*Hardness, Shore A*	*Compression set*	*Tear resistance*	*Tensile strength*	*Ultimate elongation*	*Low temp. brittle point*
			%	*lb./in.*	*p.s.i.*	%	°F.
B	Toluene diisocyanate	49	16	79	257	267	−49
C	Toluene diisocyanate/ diphenylmethane diisocyanate, 1:1	55	61	118	563	560	−43
D	Toluene diisocyanate/ dimethyldiphenyl diisocyanate, 1:1	67	65	142	640	420	−31
E	Dimethyldiphenyl diisocyanate	96	60	583	2130	710	— 5
F	Diphenylmethane diisocyanate	76	78	461	2095	837	−56

Table VII: Physical properties of polyurethanes made with toluene diisocyanate

Prepolymer[a]	*Polyester*	*Hardness, Shore A*	*Compression set*	*Tear resistance*	*Tensile strength*	*Ultimate elongation*	*Low temp. brittle point*
			%	*lb./in.*	*p.s.i.*	%	°F.
B	Polydiethylene glycol adipate	49	16	79	257	267	−49
G	Polytriethylene glycol adipate	47	52	110	410	433	−58
I	Poly-1,4-butanediol adipate	48	32	148	2278	567	−85
K	Poly-1,5-pentanediol (70%)/ diethylene glycol (30%) adipate	45	53	48	362	697	−100
M	Poly-1,4-butanediol (70%)/ diethylene glycol (30%) adipate	40	45	65	497	793	−100
O	Poly-1,5-pentanediol (50%)/ diethylene glycol (50%) adipate	53	35	77	910	873	−100
P	Poly-1,4-butanediol (50%)/ diethylene glycol (50%) adipate	47	21	76	517	607	−100

[a]See Tables II and III for properties of prepolymer.



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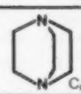
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Straining behavior of cellulose acetate plastics

By Katsuhiko Ito*

The relationship between flow strain and deformation strain of cellulose acetate plastics is examined for various conditions of working and annealing temperatures, magnitude of worked strain, rate of tensile strain, and amount of plasticizer. These strain characteristics are discussed and related to "box type" and "wedge type" relaxation spectra, respectively.

In previous articles (1, 2)[1], straining behavior of high polymer solids in compression was explained in terms of internal molecular structure for epoxy cast resin (Araldite), which is a "network" type polymer, and unplasticized polyvinyl chloride (PVC), which is a "linear" type polymer. Straining of crosslinked polymers (network type) is related solely to intramolecular micro-Brownian motion, termed "deformation strain," whereas straining of linear polymers is supplemented by intermolecular micro-Brownian motion, termed "flow strain." It was shown that deformation strain is not truly permanent, but is merely frozen by secondary bonding forces and can be recovered by an annealing process. The straining of linear polymers is much more complex (1, 3) due to the added flow strain.

These observations on straining of crosslinked polymers are true irrespective of stress state, strain rate, working temperature, etc. However, the straining behavior of linear polymers is complicated and dependent upon many factors. Experimental results obtained in tension are presented in this article.

For comparison with the previous results in compression, it would have been desirable to use PVC for these tests. However, because of local contraction, it is very difficult (4) to obtain rigid PVC test specimens that have uniform tensile strain in a moderate strain region beyond an upper yield point at room temperature. Hence, cellulose acetate plastic containing dimethyl phthalate plasticizer was used for the test specimens in this study.

The test specimen was enclosed in a chamber kept at constant temperature. The deformation of the specimen at elevated temperatures was measured by a cathetometer through a window. Tensile stress-strain curves of cellulose acetate plastics at 25° C. are shown in Fig. 1, below. The test specimens were initially strained at a constant rate of strain of 0.02%/sec. to 10, 20, and 30% of the nominal highest working strain ${}_t\varepsilon_m$ in tension. The strain recovery after removal of the load and the strain increase upon reapplication of the tensile load in the direction of initial loading are also shown in Fig. 1.

The stress-strain curves in this reloading are shown in Fig. 2, p. 130, with ${}_t\varepsilon_m$ as a parameter. The strain-hardening tendency of cellulose acetate plastics induced by tensile strain at room temperature is evident.

Effect of annealing

The stress-strain curves of specimens annealed for 6 hr. at various elevated temperatures were examined in order to determine the relation between the strain recovery (loss of oriented structure) and the worked strain. The results obtained for test specimens worked at 25° C. to ${}_t\varepsilon_m = 20\%$ are shown in Fig. 3, p. 130. It appears likely that the molecular orientation will be completely lost at an annealing temperature higher than about 125° C. The amounts of strain recovery of specimens worked to ${}_t\varepsilon_m = 10$, 20, and 30% are shown in Figs. 4, 5, and 6, p. 130, respectively. The expressions ${}_t\varepsilon_r$, ${}_t\varepsilon'_r$ and ${}_t\bar{\varepsilon}_r$ on the ordinate in these figures are defined as follows:

$$ {}_t\epsilon_r = \frac{{}_a l_i - {}_a l_f}{l_o} \times 100\ (\%) \qquad (1)$$

$$ {}_t\epsilon'_r = \frac{{}_a l_i - {}_a l_f}{l_o} \times 100\ (\%) \qquad (2)$$

(To page 130)

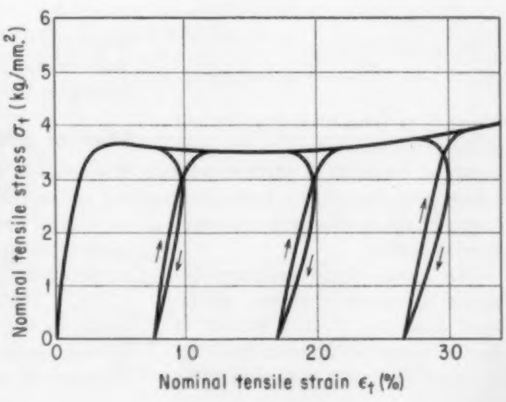


FIG. 1: Tensile stress-strain curves of specimens of cellulose acetate plastic, containing 18% dimethyl phthalate, loaded to 10, 20, and 30% of total elongation, respectively, then unloaded and reloaded. Data based on original dimensions of specimens.

*Chief, Plastics Laboratory, Institute of Physical and Chemical Research, Komagome, Bunkyo-ku, Tokyo, Japan.
[1]Numbers in parentheses designate references at end of article, p. 183.

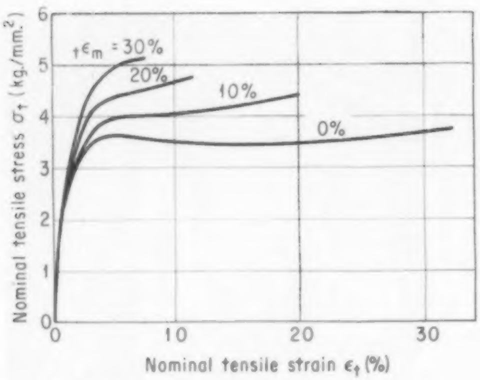


FIG. 2: Stress-strain curves of cellulose acetate plastics (DMP 18%) worked at 25° C. to various tensile strains $_t\varepsilon_m$. Data based on dimensions of worked specimens.

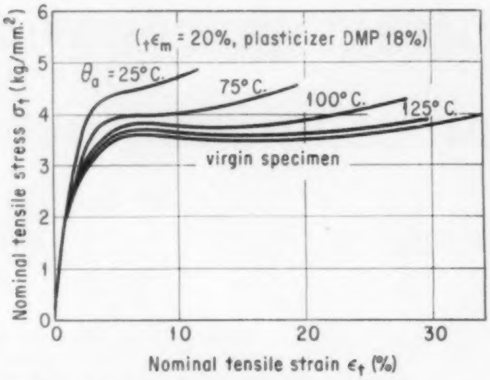
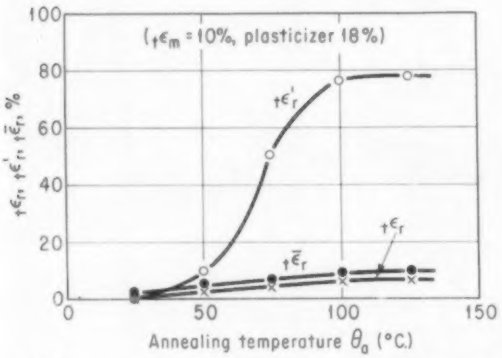
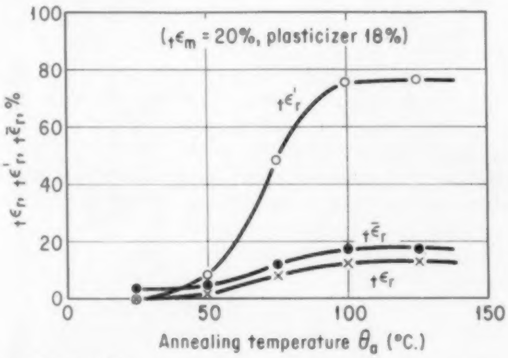


FIG. 3: Influence of annealing temperature θ_a on stress-strain curves of cellulose acetate plastics (DMP 18%) worked at a temperature of 25° C. to $_t\varepsilon_m = 20$ percent.





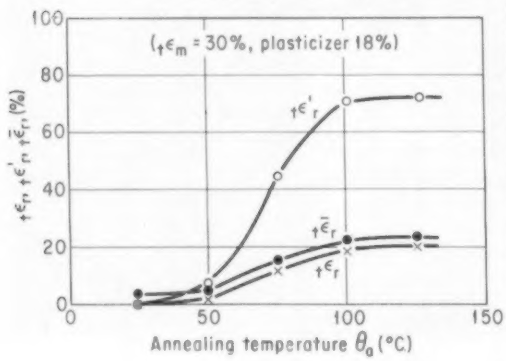


FIG. 4 (above left); **FIG. 5** (above right); **FIG. 6** (left): Relationships between annealing temperature θ_a and strain recovery of cellulose acetate plastics (DMP 18%) worked at 25° C. to $_t\varepsilon_m$ = 10, 20, and 30%, respectively.

$$_t\bar{\epsilon}_r = \frac{l_o\left(1+\frac{_t\epsilon_m}{100}\right) - {}_a l_f}{l_o} \times 100(\%) \quad (3)$$

where l_o is the initial gage length of the test specimen, $_a l_i$ is the gage length of the worked test specimen before annealing, and $_a l_f$ is the gage length of the worked test specimen after annealing.

The tensile strain recovery behavior of cellulose acetate plastic upon annealing is quite similar to that of compressive strain recovery of rigid polyvinyl chloride. The larger $_t\varepsilon_m$ is, the larger will be the ratio of the flow strain to the deformation strain.

Effect of rate of strain

As in the case of compression, test specimens were strained up to $_t\varepsilon_m = 20\%$ at various rates of strain (5) and were annealed at temperatures $\theta_a = 25$, 75, and 125° C. The strain recovery is shown in Fig. 7, p. 133. The effect of strain rate (6) on strain recovery of cellulose acetate plastics in tension is as small as for rigid polyvinyl chloride in compression. This effect, namely, the increase in flow strain accompanying a decrease in strain rate, is to be expected on considering the structure of high polymer solids in conjunction with a wide distribution of relaxation spectra (7).

Effect of plasticizer concentration

The effect of the amount of plasticizer in cellulose acetate plastics on the relationship between flow strain and deformation strain was examined for test specimens worked at 25° C. to $_t\varepsilon_m = 20\%$ and annealed at various elevated temperatures. The results that were obtained for the test specimens containing 10% and 25% DMP are shown in Figs. 8 and 9, p. 133, respectively.

The results for the test specimens containing 18% DMP is shown in Fig. 5. It is evident that the ratio of flow strain to deforma-

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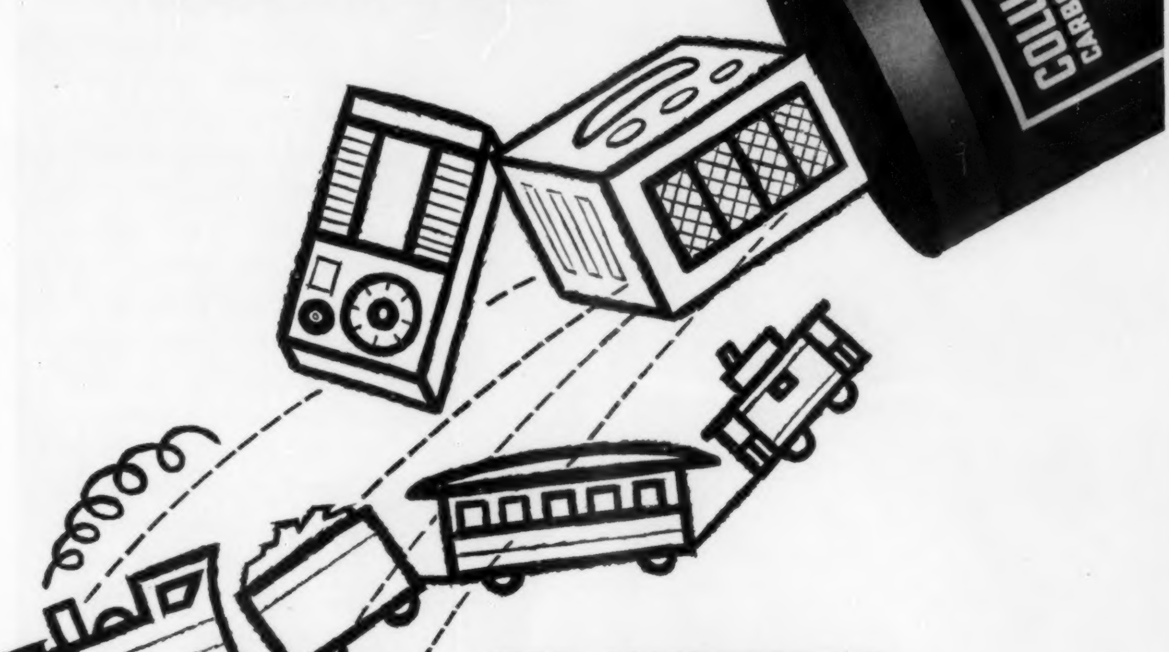

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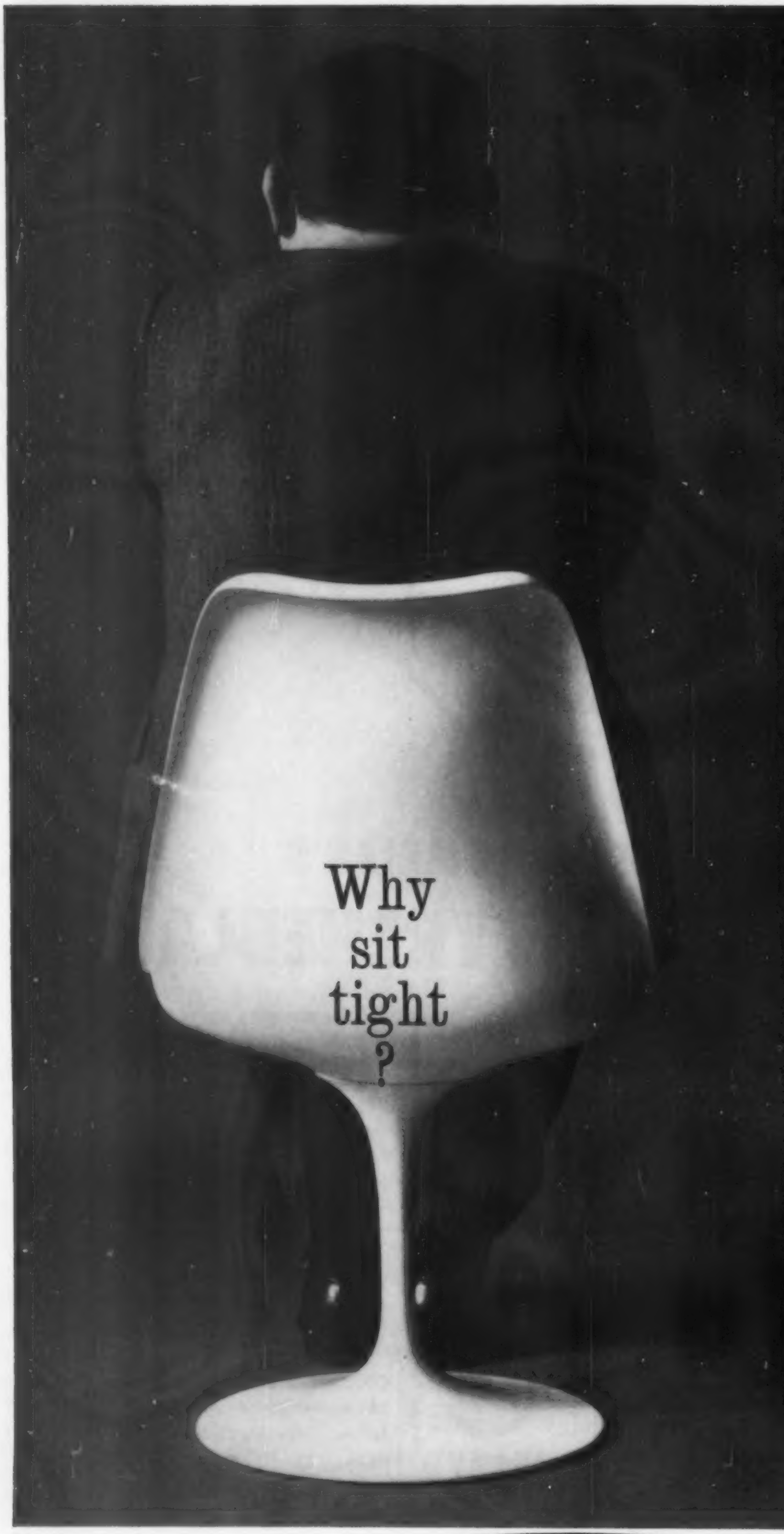

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tion strain is considerably increased by an increase in the DMP concentration.

Straining in hot state

Straining of the specimens to ${}_t\varepsilon_m = 20\%$ and removal of tensile load at elevated temperatures were performed in the same way as previously reported in compression tests (1, 2). After removing the tensile load and maintaining the working temperature θ_w for about 10 min., the strained specimens were gradually cooled to room temperature in the working apparatus. The amount of strain recovery was then measured for the specimens strained (8) at different temperatures. The results are shown in Fig. 10, below, where

$$ {}_t\bar{\epsilon}'_r = \frac{l_o\left(1+\frac{{}_t\epsilon_m}{100}\right) - {}_a l_f}{l_o \times \frac{{}_t\epsilon_m}{100}} \times 100(\%) \quad (4)$$

Specimens worked at temperatures in the region between room temperature and the temperature of transition to entropy elasticity have oriented structures. Entropy elasticity in linear polymers is likely to be caused only by entanglement between chain molecules or by coiling of chain molecules; therefore, it is more or less metastable and is not so evident as that in crosslinked polymers. The specimens were annealed for 6 hr. at temperatures higher than the working temperature. The annealing temperature was raised stepwise up to 175° C. and at each temperature the amount of strain recovery ${}_t\varepsilon_r$ was measured. (See Fig. 10.)

As expected, the thermo-recovery effect is more pronounced when the annealing is performed at higher temperatures. At low working temperatures ${}_t\bar{\varepsilon}_r$ and ${}_t\bar{\varepsilon}'_r$ are not large owing to the incomplete dissociation of secondary bonds. At high temperatures also, they are not large owing to the increase in ratio of flow strain to deformation strain. The temperature at which they are maximum is approximately equal to the dissociation temperature of secondary bonds. At first, ${}_t\varepsilon_r$ and ${}_t\varepsilon'_r$ increase with the rise of annealing temperature, eventually becoming constant due to complete recovery to a stable state. The specimen worked above the **(To page 183)**

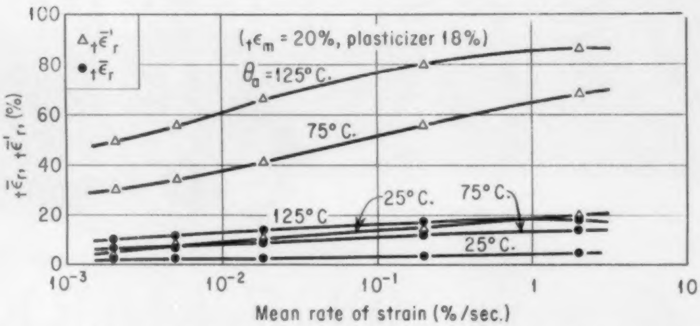


FIG. 7: Relationship between rate of strain and strain recovery at various annealing temperatures of cellulose acetate plastics (DMP 18%) worked at 25° C. to ${}_t\varepsilon_m = 20$ percent.

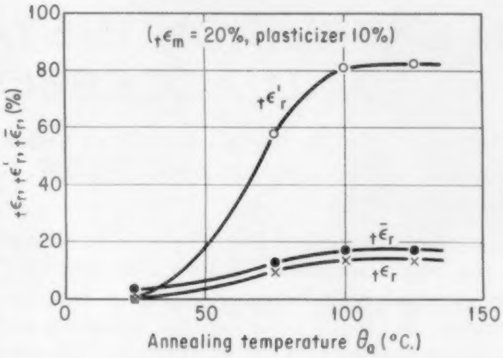
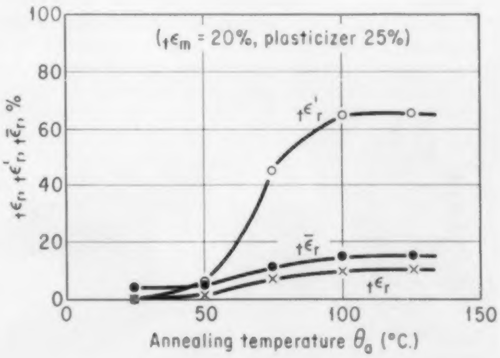


FIG 8: Strain recovery characteristics at various annealing temperatures of cellulose acetate plastics worked at 25° C. to ${}_t\varepsilon_m = 20$ percent. 10% DMP.

FIG. 9: Strain recovery characteristics at various annealing temperatures of cellulose acetate plastics worked at 25° C. to ${}_t\varepsilon_m = 20$ percent. 25% DMP.



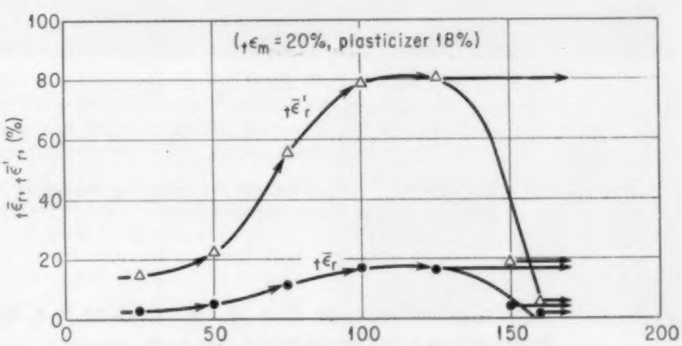
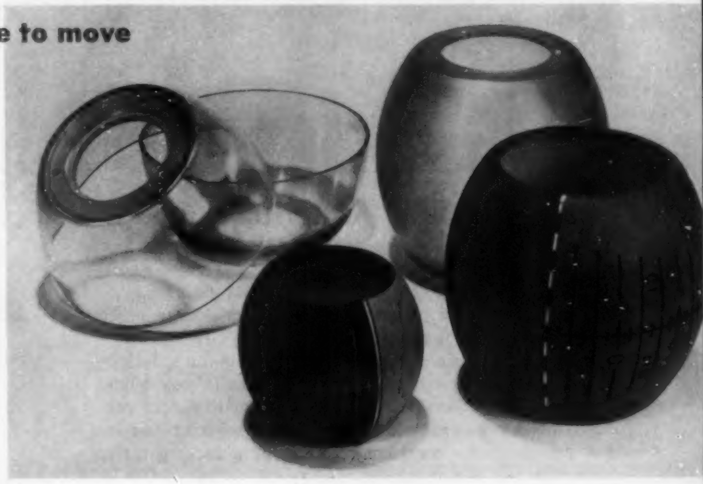


FIG. 10: Strain recovery characteristics of cellulose acetate plastics (DMP 18%) worked at various temperatures to ${}_t\varepsilon_m = 20$ percent.

Many minds at work on new ways to use plastics, new designs, and new product concepts offer ideas you can use.

Polycarbonates continue to move



Two recent applications involving polycarbonate resin give further evidence of that material's steady penetration into several markets.

The first one is a five-way binding post (above), a component for electrical and electronic equipment, made by The Superior Electric Co., Bristol, Conn. The company chose polycarbonate resin because of its creep resistance, low loss and power factor, high voltage insulation, and high resistance to ground. Integral color, high gloss, self-extinguishability, and resistance to oils, stains, and chemicals were other factors.

The second application is for aircraft instruments (above, right) by Lear Inc., Grand Rapids, Mich. The company uses polycarbonate spheres as part of its instruments. Specifications call for a maximum allowable change of 0.005 in. over a temperature range from −65 to 300° F. The spheres are produced by solvent-cementing injection-molded halves together. After being lathe-turned, the spheres are painted in three colors and marked with calibrations. The spheres are made by Monroe Industries, Grand Rapids. Lexan polycarbonate resins were supplied by General Electric Co.

Fluorocarbon saves $6700

By using an automatic molasses-feed scale lined with Teflon sheet, Beacon Milling Co., Cayuga, N. Y., has speeded production 7.5%, maintained accuracy in weighing, and saved $1,700 a year in lost man-time. The lining also ended the need to scrape off deposits of molasses at least twice daily, reducing cleaning time by 90% and resulting in savings of $5000 per annum.

The scale used by Beacon, a Richardson Belt-fed Model GB-38, is made specifically for sticky feeds. Teflon is applied to feeder side plates, leveling plate, the belt section of the feeder housing, the gate plate, and the hopper door plate. Machine shapes are also used as buffers, bushings, bearings, and seals.

Teflon sheet used in this application was fabricated by Plastic Products Div., Raybestos-Manhattan Inc., Manheim, Pa. The company provided 3-ft. squares of the sheet, 1/16 in. thick. One side of the sheet was etched to provide a bonding surface. Sheets were cut to size and shape by Richardson and bonded to the scale surfaces with R/M adhesives.

PS glazing for partitions permits new sales method

The introduction of a translucent, corrugated polystyrene rigid sheet for glazing in office partitions will enable manufacturers, for the first time, to ship the partition as well as the glazing panel in a single pre-packaged unit.

The usual customer practice of buying glazing panels from a separate source, often inconvenient or time consuming, is eliminated.

The new shipping method is made feasible by the shatterproof qualities, light weight, and ease of handling of the PS glazing sheet. Low weight of the sheet, 1 lb./sq. ft. or roughly half that of glass paneling of equal thickness (7/32 in.), keeps freight shipment rates to a minimum.

The PS glazing is extruded by The Rotuba Extruders Inc., Div. of Waljohn Plastics Inc., Brooklyn, N.Y. The material, called Extru-Lite P2, is extruded through a special die which corrugates it in a lengthwise direction. The translucent opal-white glazing is available in stock sizes up to 28 by 72 inches. For ease of installation, polystyrene material is manufactured with a smoothly-polished top edge.

(More on page 136)

TRANSLUCENT, corrugated PS sheet is designed to replace glass as partition glazing. Material is shatter-proof, weighs half as much as glass sheet of equal thickness.

New look for bowling

They've automated pinsetting, they've made palaces out of once dingy bowling emporia. But what about the lowly bowling ball? Is it forever going to remain the dull opaque black, brown, or speckled sphere that's been around for almost half a century? No sir!

Recently shown by Celanese Corp. of America was a cherry-red translucent bowling ball compression molded of polyester resin. Said to be as durable as conventional bowling balls (now generally made of hard rubber), the new variety can be produced in an almost limitless range of color and style. For example, small mica flakes incorporated during the molding operation can be scattered throughout the ball to reflect light; or club emblems, company trademarks, and artificial flowers can be embedded.

At the moment, this is an experimental item. If and when it becomes commercial, it will be directed primarily at the style-conscious lady kegler.

ABS properties spark new product designs

Among the widespread applications for acrylonitrile-butadiene-styrene (ABS), two recent examples point up the fact that the design potential of the material is a major key to its current growth in usage.

One product is an extruded ABS housing for a locking mechanism of a post binder. According to the post binder manufacturer, Wilson Jones Co., Chicago, Ill., ABS provided the dimensionally stable and shock-resistant housing that permitted the complete restyling of a locking safety catch. (See photo, top right.)

In addition to offering protection and long service life for the locking mechanism, the ABS housing has a smooth, clean surface finish that enhances the merchandising appeal of ledgers using the post binders.

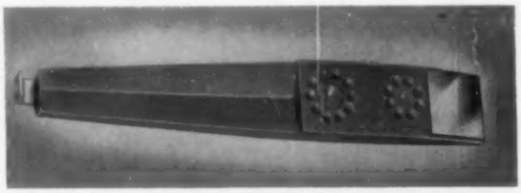
The tubular ABS housings are extruded by Sandee Mfg. Co., Chicago, which uses Cycolac material supplied by Marbon Chemical Division of Borg-Warner Corp., Washington, W. Va.

The second product, a TV and radio repair tool (also pictured, bottom right), was designed with a one-piece molded ABS body. The material's rigidity, moldability, and attractive and scratch-resistant surface were the major reasons why the designer selected this resin over two other thermoplastics.

The product was developed as a pocket tool for straightening bent radio and TV tube prongs. A metal tube puller is molded in at one end of the tool, an inspection mirror cemented to the other end, and a shirt-pocket, pen-type clip mechanically attached to the back.

Designated the "Hi-V" Tube Tool 101-T, the product weighs less than 1 oz. and is only 5⅛ in. long. The molded repair tool, which also uses Marbon Chemical's Cycolac, is made by Trout Specialty, Franklin, Ind.

EXTRUDED ABS SECTION at lower end of post binder houses an improved locking safety catch. Shock resistance of ABS housing permitted use of this redesigned locking mechanism.



PRONGS of tubes can be straightened by circular slots in TV and radio repair tool. Tube puller is molded in at lower end, and inspection mirror cemented to top.

Cast propionate giftware with decorative inserts

Unique quality is brought to a line of propionate giftware by the manufacturer's choice of casting as the production method.

According to Bilmar Plastics of California, San Rafael, casting provides a versatility in bringing out new giftware patterns which cannot be duplicated by any of the other machining techniques.

Selection of propionate (which is supplied by Eastman Chemical Products Inc., Kingsport, Tenn.) was based upon the material's attractiveness, high resistance to breakage, and freedom from odor. The designer also indicated that decorative inserts—gold foil flake, fern, and leaf designs—are considerably easier to embed in the propionate items.

The giftware line includes bowls, trays, servers, coasters, a cigarette box, candy dish, ice bucket, and candelabrum bowl. The line is sold directly to department stores, at wholesale prices ranging from $1.50 each for small cocktail trays to $25 each for 25-in. diameter bowls.

Laminate picnic plate

Insulated and disposable plastic plates for outdoor and everyday informal use are formed of laminated sheet stock consisting of high-impact polystyrene and flexible polystyrene foam films. The plates, suitable for hot and wet food, are priced to be competitive with equivalent paper products. They are produced by Guild Plastics Inc., Cambridge, Mass. Impact polystyrene and polystyrene foam film supplied by Monsanto Chemical Corp., Springfield, Mass. Twelve plates, in a printed PE bag, are list-priced at 49 cents.

Novel polypropylene housewares handle

As versatile as the product it serves, polypropylene offers strength, heat and stain resistance, "warmth" to the touch, and high gloss in the handle of a combination housewares tool recently placed on the market.

Fittings on the "Beverage Boy" permit its use as a can piercer, bottle opener, cork screw, seal cutter, and lid lifter. The cork screw is fastened and housed inside the handle, while other fittings are riveted to the outside of the PP handle. One major reason for the selection of PP was its strength in withstanding riveting operations during manufacture.

The item is available with either red or black handle, and retails for 49 cents. The manufacturer is EKCO Products Co., Chicago, Ill., which injection molds the handles using polypropylene material from AviSun Corp., Philadelphia, Pa.

Acetate for thinner eyeglass nose pads

Newly-designed eyeglass nose pads, injection molded of cellulose acetate, are said to be 30% thinner in wall section and 20% lighter than conventional pads of laminated acetate, thus providing greater comfort to those who wear eyeglasses.

The new acetate pads are offered to the optical trade by Whitney Optical Co., Woodside, N.Y., which molds them around eyeglass frame fitment inserts. The pads are produced in a 12-cavity mold on a 2½-oz. Watson-Stillman machine. Previous pads from this manufacturer were made by placing the fitment inserts between two acetate sheets and then laminating the sheets.

Cellulose acetate, virtually a standard material for eyeglass nose pads because of its high strength, resiliency, clarity, and stain resistance, is supplied by Eastman Chemical Products Inc., Kingsport, Tenn.

LOWER SECTION of handle is extruded RP rod, will flex under pressure to push mop head into inaccessible dusting areas.

Flexible reinforced plastic mop handle

Dusting of hard-to-get-at spots under beds, tables, and other furniture is simplified in the new Zephyr Elasto-Mop by means of a flexible handle section extruded from glass-reinforced polyester resin.

The flexible rod, which forms the lower portion of the mop handle, provides the bending action which places the mop head under furniture for dusting, enabling the user to stand erect while working. The rigid upper portion of the handle, made of metal, permits the user to control the direction of the mop head.

The mop is made by Zephyr Mfg. Co., Sedalia, Mo. Flexible RP sections are extruded by Francis Industries, Pataskala, Ohio, using resin supplied by Interchemical Corp., Finishes Div., Newark, N. J.

Vinyl printing plates outlast rubber 5 to 1

A vinyl engraving material, developed for use in printing multiwall kraft bags, has already outlasted by five times the gum rubber printing materials previously used at one plant.

Printing plates made from the new material, Koroseal 60 (B.F. Goodrich Industrial Prods.), have given more than 2 million printing impressions in use by St. Mary's Kraft Bag Co., Div. of Gilman Paper Co., St. Mary's, Ga. Printing plates of the former gum materials delivered from 400,000 to 450,000 impressions at the maximum.

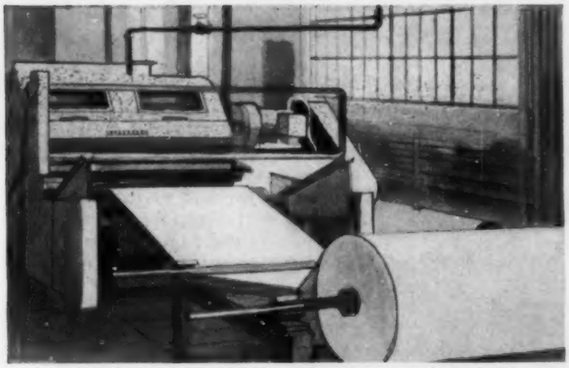
Behind the success of the vinyl plates is the fact that, unlike rubber plates, they do not distort under printing pressures; therefore, press speeds do not have to be slowed down to let the flexible plates recover their shape. This permits press speeds up to 30% faster than those possible with conventional rubber plates. Other advantages: better ink coverage in large solid and band areas because they release ink more readily than rubber plates; excellent ink coverage; and faster plate cleanup.

Polyethylene bumper protects glass labware

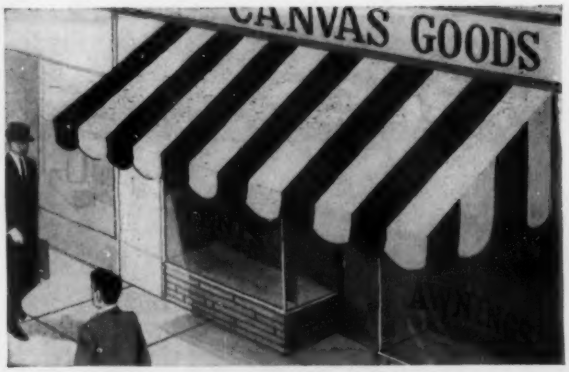
By placing a molded polyethylene "washer" around the neck of graduated glass cylinders for laboratory use, breakage and chipping of accidentally tipped-over containers is eliminated. When a cylinder is tipped over, impact occurs on the PE bumper rather than on the glass. Designated Safe-Gards, the units can also be used as markers—when lined up with a graduation mark, they serve as a visible check point to gage volume poured.

The plastic ring is cut on one edge to allow it to be slipped easily around the cylinder. Once installed it fits snugly and will not slip. Six sizes, to fit cylinders from 25 to 250 ml., are available. The item is made by Kimble Glass Co., a subsidiary of Owens-Illinois, Toledo, Ohio.

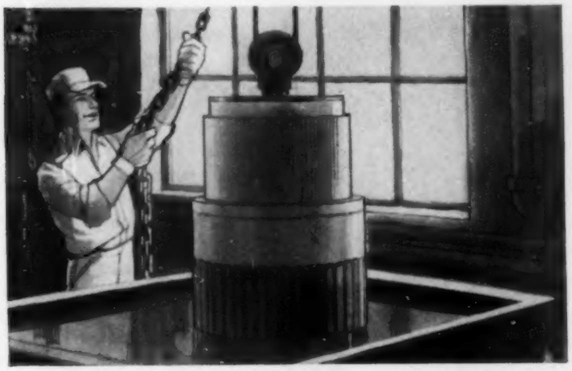
(More on page 140)



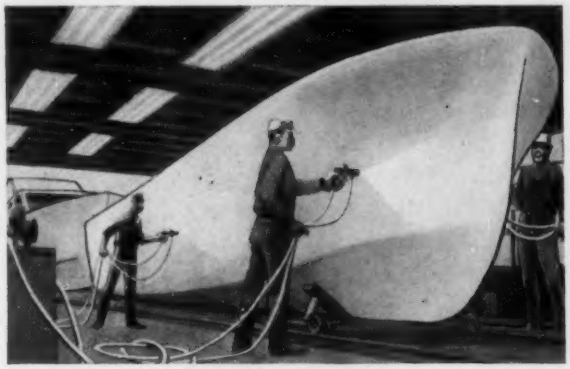
Control uniformity of film thickness in vinyl plastisol and organosol coatings for paper or cloth, with BENTONE 27 or BENTONE 38 gellants.



Control penetration on porous surfaces—the right BENTONE gellant will minimize "wicking" of resin coatings on cloth, paper, concrete.



Minimize sagging and running when dip-coating electrical parts with epoxies. BENTONE gellants help control flow during dip and cure.



Control suspension of pigments, extenders, fillers in polyester gels and gel coats. BENTONE 27 gellant provides thixotropic flow control during application.

4 plastic coating problems you can solve with BENTONE® 27 or BENTONE® 38 gellants

Here are only a few of the many problems you can solve with two BENTONE® gellants—especially those problems involving efficient control of viscosity, particle settling, penetration or flow properties.

You can pinpoint the precise viscosity needed for best results with epoxies, polyesters, vinyl dispersions—by "building in" the right BENTONE gellant. Generally, BENTONE 27 gellant is for use with high polarity solvents. BENTONE 38 gellant works best with low to medium polarity compounds. Both provide highly efficient particle suspension and contribute to control of uniformity in color, film thickness and other physical properties.

Many advantages in application, curing and storage. Better dip coating—with little or no sag during cure. Spray coatings have uniform suspension properties—improved color uniformity. Adhesives and other coatings have effective penetration control—and reproducible viscosity control.

BENTONE gellants work well with many solvents—including aromatic and aliphatic hydrocarbons, esters and ketones. Gels produced by BENTONE gellants are stable in storage—no separation of components or gel contraction.

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BENTONE® *A Chemical Development of* **National Lead Company**
(Gellants)
111 Broadway, New York 6, N. Y.

All-purpose polyethylene tote bag

Suggested for shopping, picnics, and visits to the beach, waterproof polyethylene bag is fabricated by Kahn Mfg. Co. Ltd., Hatfield, Herts., England, of 400-gage film extruded from resin supplied by British Cellophane Ltd. The film is ribbed at 1/8-in. intervals during extrusion by a special process developed jointly by the two companies to provide extra strength and an attractive finish. Details on the process are not available.

At the mouth of the bag, the film is folded double, and this fold is pierced by 8 metal eyelets, through which a PE string, for closing the bag, is run. The bags are 13 by 15 in. in size. Retail price: 35 cents.

RP insulators best for busway economy, safety

A switch from insulated metal brackets to one-piece reinforced-plastics insulators for bus bar supports has netted one busway manufacturer a 50% reduction in assembly time, 30% lower weight, and improved electrical safety in busway handling.

The glass/polyester laminate supports are used by Electric Distribution Products Inc., Allentown, Pa., as spacers on its Uni-Bus line of busway systems. The former bus bar support consisted of a metal bracket of 11 individual pieces, with an average of six brackets required for each 10-ft. section of busway. With the metal brackets, the production schedule was 50 busway sections per working day.

This schedule has now been increased to 100 sections per day with the RP components. Supports are simply inserted into stamped slots and held in place by compression of the assembled busway. And although the RP spacers cost about 29% higher than the metal brackets, they actually effect a net saving due to the faster busway assembly time.

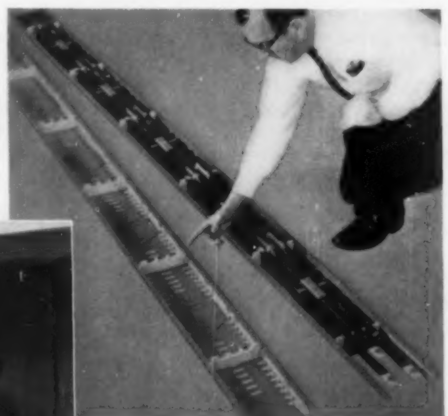
A former 600-amp. busway with aluminum bus bars and metal brackets weighed about 80 lb. per 10-ft. section. Units with the RP supports weigh only 55 lb. in the same rating. This reduction not only cuts freight costs, but also simplifies handling, storage, and installation.

Featured in the new busway line is Polyair Insulation, which is the combination of the RP insulators and increased air space, permitting a minimum of 7/8 in. ground clearance, well within the 1/2-in. requirement of Underwriters' Laboratories. Insulation efficiency is further upgraded by a double wrapping on the bus bars of varnished cambric tape and flame-resistant polyvinyl chloride tape.

The new RP supports are highly resistant to breakage from improper handling and from the mechanical stresses set up during circuit failure. The RP parts are said to be about 25 times stronger than ceramic insulators, and they will not chip or crack.

Each support is approximately 6 in. long and 1/4-in. thick. They are punched from laminated glass/polyester sheets and supplied in finished form by National Vulcanized Fibre Co., Wilmington, Del.—**End**

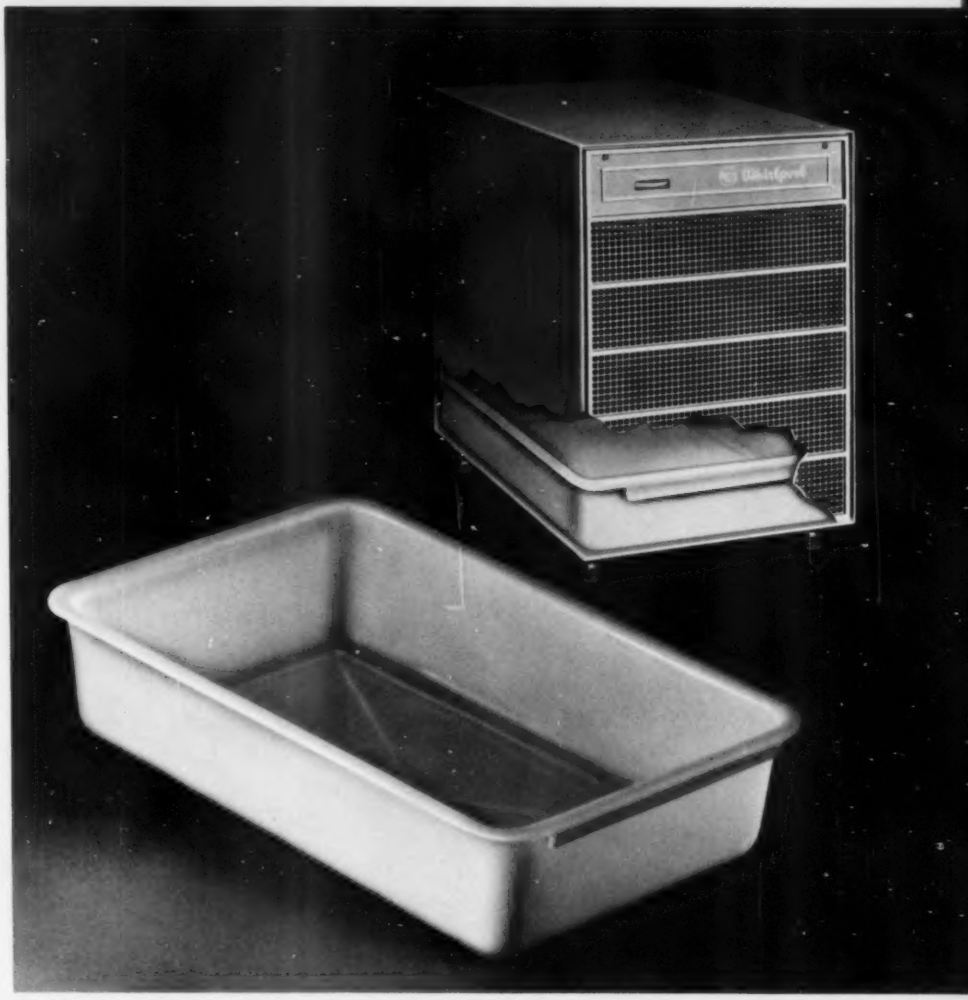
PUNCHED in one piece from reinforced plastic laminate sheet, insulator is easily inserted into stamped slots of busway section. Parts are held in place by compression of busway cover and need for mechanical fasteners is eliminated.



BUSWAYS for light and power supply feature reinforced-plastic supports and spacers for bus bars. RP components replace insulated metal brackets in busway.

working with Du Pont **Alathon**®
polyethylene resins

one of Du Pont's versatile engineering materials



Large, thin-walled drip pan is molded of ALATHON® 7050 to solve warpage problem

The design and production of this dehumidifier drip pan involved a critical choice of the proper molding resin. With dimensions of 10″ x 16″ x 3½″, and a wall thickness of only .075″, the pan might have presented problems of warping. After testing several competitive materials, the processor found that Du Pont ALATHON 7050, a high-density polyethylene resin, provided an ideal solution. This ALATHON resin exhibits the required dimensional stability to prevent warping immediately after molding and also after aging. In addition, it has the toughness and stiffness needed as well as good color and high gloss.

The pan is molded by The Metal Specialty Company, Richmond, Indiana, for the Whirlpool Corporation, Benton Harbor, Mich.

This is one more example of the design problems solved by the proper choice of an ALATHON resin. You will find in the family of polyethylene resins offered by Du Pont a formulation tailored to meet your specific needs. The following page shows six additional applications of ALATHON polyethylene resins, illustrating the versatility of these materials. For information that will help you select the right resin for *your* use, mail the coupon on the next page.

DU PONT
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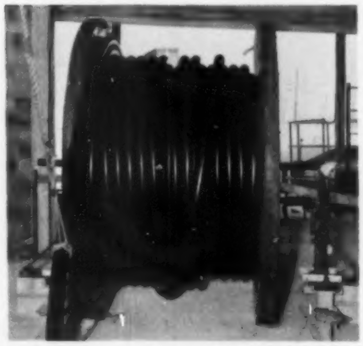
BETTER THINGS FOR BETTER LIVING... THROUGH CHEMISTRY

Flexible pipe made of ALATHON 25 polyethylene resins is extra-strong, exceptionally tough even in coldest weather. Pipe stands up to years of contact with corrosive soils and atmospheres. It has outstanding resistance to outdoor weathering. It is another example of the special tailoring of a resin for a specific need.

Whether it's a coating, a molding or extrusion, there's an ALATHON® resin tailored for the job

Ball retainer guide for flush toilet tanks assures alignment, saves water, stops annoying leakage. Unit is molded of ALATHON 17 to provide rust-free, corrosion-free service. As the water leaves the tanks, the rubber ball "follows" the guide down, is automatically centered over the flush valve. (By Culp Brothers Mfg. Co., Phila., Pa., for Valguard Co., Inc., Port Deposit, Md.)

A coating of ALATHON 16 polyethylene resin on film is used for skin-packaging electrical heater tapes. The heat-sealed coating provides durable film-to-paperboard adhesion, allows rapid, low-cost package production. (Drapex™ film by Riegel Paper Corporation, New York, for Smith-Gates Manufacturing Corporation, Farmington, Conn.)



Jacketing of ALATHON 1000 BK-30 provides protection for cable elements, remains tough and flexible even at low temperatures. The excellent physical properties of ALATHON allow thin jackets to be used, thus reducing over-all diameter and weight. Jacketing of ALATHON is lightweight and easy to strip, facilitates installation.

Golf-swing-improvement device, used to develop or improve "inside-out" swing, has lightweight, tough base in bright green, molded of ALATHON 17. The white flaps require outstanding flexural strength; to meet this need, they are molded of ALATHON 14 polyethylene resin. (By Dale Plastics, Detroit, Michigan.)

"Pour and Store" bags for individually frozen vegetables need the right polyethylene resin for the right film—film that's tough, yet clear . . . easily printable, easy to seal, flexible at well below freezing temperatures. ALATHON 1402 does it. (Film by Flexible Packaging Div., Continental Can Co., for Snow Crop Div., Seabrook Farms.)

POLYOLEFINS DIVISION

POLYCHEMICALS DEPARTMENT

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Delrin® acetal resins · **Lucite®** acrylic resins · **Zytel®** nylon resins

LITERATURE

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Electronic Packaging with Resins: A Practical Guide for Materials and Manufacturing Techniques," *by Charles A. Harper.*

Published in 1961 by the McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y., 360 pages. Price: $11.00.

A practical guide and reference for applications involving the casting, potting, impregnation, and encapsulation of electrical components and systems. Materials discussed include epoxies, polyesters, silicones, urethanes, polysulfides, and many others. Modifiers such as diluents, plasticizers, fillers, colorants, and catalysts are also treated. Also included are chapters on processing equipment, tools and molds, fixtures, testing methods, and process controls. A must for the electronics and plastic engineer working in the encapsulation field.—*G.R.S.*

"Glass Fibre Reinforced Plastics," *Advisory Editor—A. DeDani.*

Published in 1961 by Interscience Publishers Inc., 250 Fifth Ave. New York 1, N. Y., 296 pages. Price: $9.75.

Starting out with a section on raw materials and more detailed discussions of the fibrous glass reinforcement and polyester resins, the author includes chapters on other resins, auxiliary materials, molding methods, jigs, tools, finishing operations, and properties of the glass reinforced laminates. The book is loaded with detailed practical know-how on exactly how to get into the production of fibrous glass reinforced items. Indicative of the thoroughness are the chapters dealing with the set-up of the molding shop and the chemical, physical, and quality control test laboratories. Good reading for the beginner or expert in fibrous glass laminate technology.—*G.R.S.*

"British Plastics Year Book (1961)"

Published in 1961 by Iliffe Books Ltd., Dorset House, Stamford St., London SE1, England. 712 pp. Price: 47s. ($6.50).

Said to be the only comprehensive classified guide to the plastics industry in the United Kingdom, this 10-section edition includes such data as a classified listing of manufacturers and suppliers of materials, finished products, and equipment; companies offering specialized services; tradenames; technical data and related charts and graphs; who's who in the U. K. plastics industry; etc. Contains names and addresses of over 3000 U. K. plastics firms, and more than 4000 overseas listings for the U. S. and about 50 other countries.

Polycarbonate resin. "Where to Buy Lexan Polycarbonate Resin in Standard Fabricated Shapes" lists sources of supply for Lexan film, sheet, plate, slabs, disks, tubing, and rod. Bulletin CDC-389. 4 pages. *Chemical Materials Dept., General Electric Co., Pittsfield, Mass.*

Epoxy resin. Physical and electrical properties, chemical resistance, and other technical data for Bakelite flame-retardant epoxy resin ERL-0625, which is used for hot-melt castings and dry lay-up laminating systems. 4 pages. *Union Carbide Plastics Co., 270 Park Ave., New York 17, N. Y.*

Plastics resins. Illustrated brochure, with text in English, Italian, French, and German, describes the complete line of synthetic resins and chemicals —phenolic molding powders; phenolic, urea, melamine, alkyd, maleic, unsaturated polyester, and polystyrene resins; plasticizers; etc.—produced by this Italian company. 36 pages. *Societa Italiana Resine, Via Grazioli, 33 Milano, Italy.*

Coatings. General characteristics and uses for 17 special coatings, many of which have applications for plastics products and components. 4 pages. *Service Products Div., Johnson's Wax, Racine, Wis.*

Plastic coating for metal. Physical characteristics, corrosion resistance, methods of application, etc., for Pfaudlon 301, a corrosion-resistant, Penton-based, sprayable coating for metal ducts, tanks, vessels, valves, etc. Bulletin 1007. 4 pages. *Pfaudler Division, Pfaudler Permutit Inc., Rochester 3, N. Y.*

PE for pipe extrusion. Physical properties, pipe extrusion data, pipe properties of Tenite polyethylenes, etc. Materials Bulletin 1. *Eastman Chemical Products Inc., Kingsport, Tenn.*

Casting resins. "Recent Developments in Casting Resins and Technology for Electrical Encapsulation Applications" is the third in a series of PLASTEC reports. This study presents data on recent developments in plastic casting resins, processing techniques, and test methods, covering epoxy, silicone, polysulfide, polyurethane, polyester, and hydrocarbon. PB 171 034. 34 pages. Price: $1.00. *OTS, Department of Commerce, Washington 25, D. C.,* or nearest district office.

Custom molding facilities. Brochure outlines the vacuum forming, pressure forming, and blow molding facilities available. Includes photos of applications such as toys, displays, packaging, and industrial parts. 12 pages. *Chanal Plastics Corp., 63-20 Austin St., Rego Park 74, N. Y.*

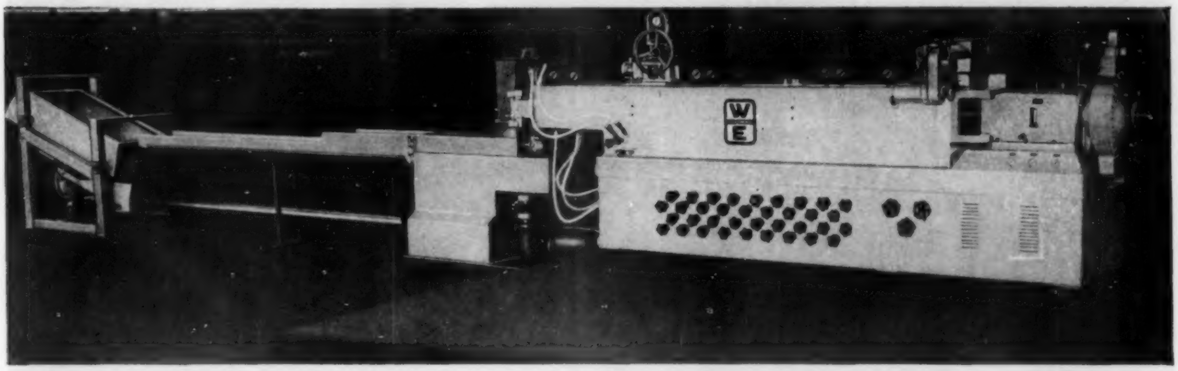
Reference charts for injection molders. Two charts, for wall mounting, make it easy for injection molders to calculate heating cylinder plasticating capacity requirements in pounds per hour. Chart A is for cycles running 2 to 31 sec.; Chart B for machines running on 31- to 120-sec. cycles. 2 pages each. *Injection Molders Supply Co. Inc., 17601 S. Miles Rd., Cleveland 28, Ohio.*

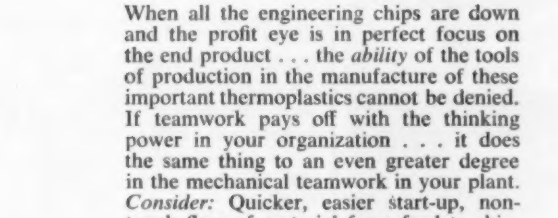
Dry coloring of plastics. New color chip booklet contains 72 chips, together with information and prices. Includes both color concentrates and dry color for all thermoplastic materials. c. 38 pages. *Plastics Color Co., 22 Commerce St., Chatham, N. J.*

Vinyl resins for plastisols and organosols covers all aspects of formulation, mixers. Tilting types range from 5 to 200 gal.; nontilting types range from 20 to 1000 gallons. Bulletin 1260. 8 pages. *The J. H. Day Co., 4932 Beech St., Cincinnati 12, Ohio.*

Polyester resins. Brochure, available in French, German, Dutch, or English, describes this company's line of eight Setarol polyester resins and 11 Synthese polyester pigment pastes. Includes properties, characteristics, gel time tests, application data, etc. 18 pages. *Kunstharsfabriek Synthese N. V., Katwijk, Ann Zee, Holland.*

Technical service facility. "A New Link with Your Company's Future" describes the company's new Technical Service Center, being completed this year, which will concern itself primarily with technical service problems, and will provide customers with the latest technological advances in





newer and improved products. 8 pages. *Naugatuck Chemical Div., United States Rubber Co., Naugatuck, Conn.*

Conveying systems and allied equipment. "Bulk Materials Handling Equipment for the Process Industries" outlines features, dimensions, uses, and other data for four standardized pneumatic conveying systems for handling plastics and other materials. Bulletin 228. 8 pages. "Moyno Pump Conveying Systems for In Plant Transfer Units Cut Dusting Problems to a Minimum" discusses the features and general layout of this system, which handles PVC powders and other materials. Specification Sheet 229. 2 pages. *Sprout, Waldron & Co. Inc., Muncy, Pa.*

Injection nozzles. Specifications, prices, and features of a line of plastic injection machine nozzles and color dispersion insert unit. 4 pages. *Header Tool Co., 24474 Telegraph Rd., Southfield, Mich.*

Fibrous glass-reinforced plastics. "Cimastra . . . New Concepts of Design and Color in Reinforced Plastic" outlines the design facilities, types of products produced, etc. *Cimastra Div., The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.*

Plasticizers. Physical properties, specifications, low-temperature performance, compatibility with plastics and rubbers, and other technical data for a line of low-temperature, polymeric, and epoxy plasticizers tradenamed Plastolein. 30 pages. *Emery Industries Inc., 4200 Carew Tower, Cincinnati 2, Ohio.*

Extruders. Specifications, models available, features, and other data for a line of plastics extruders, including descriptions of commercial and laboratory extruders used in plastic coating of paper board and other web materials, Mark V dies, plastic pelletizing systems, and special extruders. Bulletin HK-10. 12 pages. *Hale and Kullgren Plastics Dept., Black-Clawson Co., 613 E. Tallmadge Ave., Akron, Ohio.*

Decorative plastic laminates. Color chart illustrates 64 colors and patterns for the entire Micarta "Holiday in Color" line of decorative plastic laminates. *Micarta Div., Westinghouse Electric Corp., Hampton, S. C.*

Polyethylene Film Extrusion, an operating manual, contains the accumulated knowledge of this firm's technical service and engineering staffs of the "best procedures known to the

industry for high-quality PE film at optimum production rates." The manual describes the extruding machine and the function of its parts; defines the problems that operators and maintenance men have to cope with; helps to maintain the highest degree of safety; etc. 56 pages. *U. S. Industrial Chemicals Co., 99 Park Ave., New York 16, N. Y.*

Dry Coloring Thermoplastic Resins with Ferro Colors explains advantages of this process, equipment requirements, procedure, prices, etc. 6 pages. *Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio.*

Ultraviolet-resistant PE. Bulletin describes the results of tests upon Tenite polyethylene formulations with high resistance to sunlight and outdoor weathering. Formulations incorporate a non-pigment-type of UV inhibitor. Materials Bulletin 5. 2 pages. *Eastman Chemical Products Inc., Kingsport, Tenn.*

Vinyl resins for plastisols and organosols covers all aspects of formulation, processing methods, and applications for Bakelite resins. 24 pages. *Union Carbide Plastics Co., 270 Park Ave., New York 17, N. Y.*

Polystyrene sandwich panels. Specifications, thermal properties, applications, and other technical data for a line of rigid Dylite expanded sandwich panels—available in size and thickness up to 8 by 20 ft. by 10 in. —for curtain walls, insulation, and other building uses. 6 pages. *Clark Industries, Division of Clark Grave Vault Co., 375 East 5th Ave., Columbus 1, Ohio.*

PVC paste resin. Properties, rheological characteristics, fusion conditions, formulating and compounding techniques, etc., for Marvinol VR-50, a stir-in paste-grade resin used for plastisol and organosol applications. 18 pages. *U. S. Rubber Co., Naugatuck Chemical Div., Naugatuck, Conn.*

Injection molding machine. Specifications, models available, and features for a line of injection machines. 8 pages. *Lester-Phoenix Inc., 2711 Church Ave., Cleveland 13, Ohio.*

Worm gear motors. Features, ratings, and dimensional data for a line of right-angle worm gear type motors for use in the plastics and other industries. Speeds range from 3.25 to 230 r.p.m.; hp. ratings are 1/3, 1/2, 3/4, 1, 1 1/2, and 2. Bulletin F-1971. 6 pages. *U. S. Electrical Motors Inc., P. O. Box 2058, Terminal Annex, Los Angeles 54, Calif.*—**End**

New machinery-equipment

(From pp. 46-52)

a variable speed motor drive. The hammer's length of vibration is 0.002 in. or greater on the power stroke. Standard width of seal is a maximum of 0.125 inch. *Mayflower Electronic Devices Inc., Little Ferry, N. J.*

Dispensing gun

Automatic metering gun dispenser can be used for the application of adhesives in assembly work or the dispensing of potting compounds, etc. Miniaturized for easy mounting into production equipment set-ups, the gun's metering piston is actuated by material pressures from 50 to 2500 p.s.i. (determined by material viscosity). A special valve automatically cycles the gun. Material may be exactly placed where needed by the gun's nozzle and any excess material is drawn back into the gun at the end of each delivery, eliminating drips. Cycling frequency and shot size may be adjusted without stopping the gun. Maximum shot size is 4 c.c. Guns are designed for use with the manufacturer's line of materials-pumping equipment. Shop air pressure of 60 to 70 p.s.i. is required. Special gun nozzles are available. *Pyles Industries Inc., 20855 Telegraph Rd., Detroit 41, Mich.*

Injection machine

Made by the Argyle Engineering Co., this Model 4-125 3¾-oz.-capacity injection machine has a plasticating rate of up to 75 lb./hr. and is equipped with a toggle clamping mechanism. The injection stroke is 8 in. and platen area is 14½ by 21 inches. Cycling speed is 720 strokes per hour. The machine has built-in water-cooling lines and a water-cooled plunger to maintain the proper clearance between the plunger and feed bushing, thus minimizing galling or sticking of the plunger. Plug-in timers are used to facilitate maintenance. *Bell Machinery Co. Inc., 4439 Sante Fe Ave., Los Angeles 58, Calif.*

Sheet cutter

The Model 4 Type HS Autogil guillotine cutter is designed for production pieces of any length from ⅟₁₆ to 4 in. from webs up to 4 in. wide. Operating speed is 300 cuts per minute. It is equipped with solid steel feed rollers operated intermittently by means of a mechanical crank throw arm through a one-way mechanical clutch. *Hobbs Autogil, 24 Salisbury St., Worcester, Mass.*

Resin degasser

For use in casting and potting operations, a vacuum in the degasser is used to draw liquid from the storage container, through a demand inlet valve, into the heating and rough degassing section. The material then flows through the film-state fine degassing section into a controlled-level reservoir. A variable-speed, air-driven output pump feeds the degassed material out as needed or recirculates it. Unit is available in several capacity ranges and with heater temperatures up to 150° C. Either 110- or 220-v. power is required for the heaters (110-v. for controls), as well as air at 60 to 120 p.s.i.g. at 4 to 10 cu. ft./min. and a vacuum supply of 1 mm. of mercury. *Automatic Process Control Inc., 1001 Morris Ave., Union, N. J.*

Injection machine

In the Stokes Model 706 12-oz. reciprocating screw injection machine, the screw in the plasticating cylinder is rotated by a shaft which is connected to the injection piston in the ram cylinder. A hydraulic motor with continuously variable speed control rotates both piston and screw within their respective cylinders. The drive is so designed to allow axial movement of the screw and piston. Plasticating ca-

pacity is 100 lb./hr., and the rate of injection is 875 cu. in./min. on a stroke of 5 inches. Maximum injection pressure is 20,600 p.s.i., which is delivered by the 2½-in. screw. Maximum clamping pressure is 300 tons on a clamp stroke of 12 inches. Distance between tie rods is 24 by 10 in., and mold daylight is adjustable between 26 and 34 inches. The ejection stroke is 4½ in., and exerts a 9½-ton ejection force. The injection press is equipped with 17 kw. for heating, and requires air at 2 cu. ft./min. at 90-p.s.i. pressure. *F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.*

Pressure-forming machine

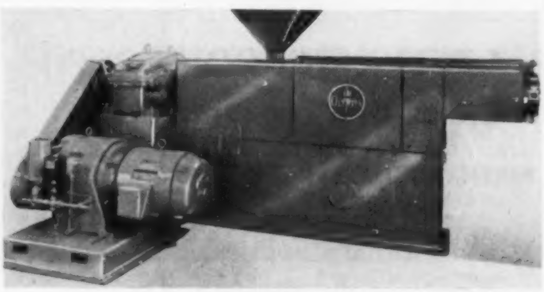
The model P-88 machine is designed for sampling and development work. It has a 10- by 10-in. heater area and an 8- by 8-in. forming area. Maximum forming depth is 4 inches. Platen stroke is adjustable from 0 to 5 inches. Operating temperature range is 100 to 600° F., and maximum forming pressure is 150 p.s.i. Control panel includes two timers, three pressure regulators, and four push-button electrical system controls. Utilities required: 3-phase 60-c.p.s. power at 220 v. and 9 a., and air supply of 3 cu. ft./min. at 80 p.s.i. minimum. *Producto Machine Co., 935 Housatonic Ave., Bridgeport 1, Conn.*

Injection machines

Four extruder-type preplasticating injection machines are being offered by H-P-M; two IX single-stage machines, and two PX two-stage machines. In the IX single-stage machine, the extruder is used to plasticate the material and as the plunger for injection. This type of machine is recommended for heat-sensitive materials. In the PX two-stage machine, the extruder is used to plasticate the material and feed it to a second-stage shooting chamber. The shooting chamber has a rotary material control valve, and positive mechanical shot measurement. This model is recommended for thermally stable viscous material where accurate shot weight control is required. Single-stage machines are available with shot capacities of 15 and 40 oz., and plasticating capacities of 150 and 300 lb./hr., respectively. Two-stage models have capacities of 28 and 50 oz.; plasticating capacities of 150 and 300 lb./hr., respectively. Clamping systems from 200 to 1000 tons for use in conjunction with the above injection systems are available. *H-P-M Div., Koehring Co., Mt. Gilead, Ohio.*

Extruder

New 4½-in. extruder has an L/D ratio of 24:1 in a cylinder centerline located 42 in. above the floor. It has a one-piece Xaloy cylinder, an extra heavy thrust assembly, continuous forced filtered oil system, a flexible



coupling between gear transmission and thrust unit, tangential water-jacketed feed section, and a herringbone gear reducer. It is equipped with a 60-hp. motor, but other motors are available. There is a choice of heaters, screws, and design of frictional control and control panel. *Olympia Tool and Machine Co., 119-121 Delancy St., Newark 5, N. J.*—**End**

Powder molding

(From pp. 80-83)

is using it in its own operation to feed resin into the molds.

A fishing tackle carrying case produced by Amos is another good example of the versatility of the process. Measuring 5 ft. long and 6¼ by 2½ in. wide, with a wall thickness of 0.125 in., the case appears to be nothing more than a simple extrusion. On closer inspection, however, it turns out to be decorated with a stippled or diamond pattern effect on the outside, something not possible with the extrusion process. In addition, by using several molds, it is produced at a price competitive with extrusion. It weighs 2½ lb., and, with vinyl end caps, retails for $14.95.

What are the economics?

Some of the sizes currently being produced by powder molding are clearly beyond the capacities of present-day vacuum-forming, injection, and blow-molding equipment. However, there is an area of overlap where all four of these techniques (plus some others) should be carefully weighed.

Size: How this influences the choice of processing method is perhaps best illustrated by two hypothetical items.

Assume a piece is 48 by 48 by 1 in., with a 0.064-in. wall thickness, and a weight of 5⅓ pound. Powder molding this item, using two molds and an hourly production of 50 lb., results in a cost per molded pound of about $1.50, or a total price per piece of $8.25. This does not include tooling cost, which for a product of this size runs to about $400 per mold ($800 for the two molds). A resin cost of 35¢/lb. in truck-load quantities is assumed in these examples, exclusive of any royalties involved.

This same product vacuum-formed by a processor who extrudes his own sheet and pays about 27½¢/lb. for the resin, can be made at about $3.25 for the piece, using one mold. Again, mold costs are not included in the unit cost.

Clearly, vacuum forming is the more economical process.

But now assume a product has dimensions of 48 by 48 by 24 in., a 0.150-in. wall, and a weight of 35 lb., with 150 lb. of resin processed per hour, using two molds at a total cost of $1600. Cost per molded pound for this product is less than 99¢.

Thermoforming this size would result in a price per formed pound of over $1, assuming it can be done at all; and as size increases this discrepancy grows in favor of powder molding.

When we deal with sizes that cannot be injection molded, vacuum formed, or blow molded, reinforced plastics molding enters the picture.

As a general rule of thumb, the piece cost of powder-molded products is somewhat higher than matched metal-molded items; however, mold costs for the latter are considerably higher, and it will be the length of the run that will determine the final choice (see below). Hand layup results in a molded piece cost said to be 10 to 30% above powder molding. This does not take into account mold costs and differences in properties.

Boats represent a good area of

comparison. The craft pictured on p. 81 is 9½ ft. long and has a 48-in. beam. It is powder molded by Amos-Thompson and sells for $375, fully equipped, including sail. An equivalent reinforced plastics boat would retail at about $425 to $450. The hulls alone are $65 and $75.

For very large sizes (exceeding 500 gal. in capacity), reinforced plastics molding or welded sheet fabrication are probably the most likely techniques. It is doubtful whether self-supporting powder-molded parts can be produced in those capacities. Sizes above 500 gal. have been powder-molded; however, they require supporting frameworks or internal reinforcements, which increases costs.

Length of run: This factor becomes particularly important when powder molding is compared with injection molding. Again, let's take a hypothetical example. Assume a wastebasket with molded-in decorative finish, measuring 20 in. high, with a diameter of 14 in., a wall thickness of 0.080 in., and a weight of 2.61 pounds.

If this basket is produced by powder molding, using 6 molds at $500 each (for a total of $3000), price per pound molded is $1.06, and the price of the basket is $2.82. Again, this does not include mold amortization. For a run of 6000 units, we would have to add 50¢ to the piece price, making it $3.32.

If the basket is injection molded, cost per molded pound would be about 49¢ or $1.28 for the piece. A stippled injection mold for this wastebasket might run about $18,000. At a run of 6000, this would add $3 per piece, for a total of $4.28 per basket.

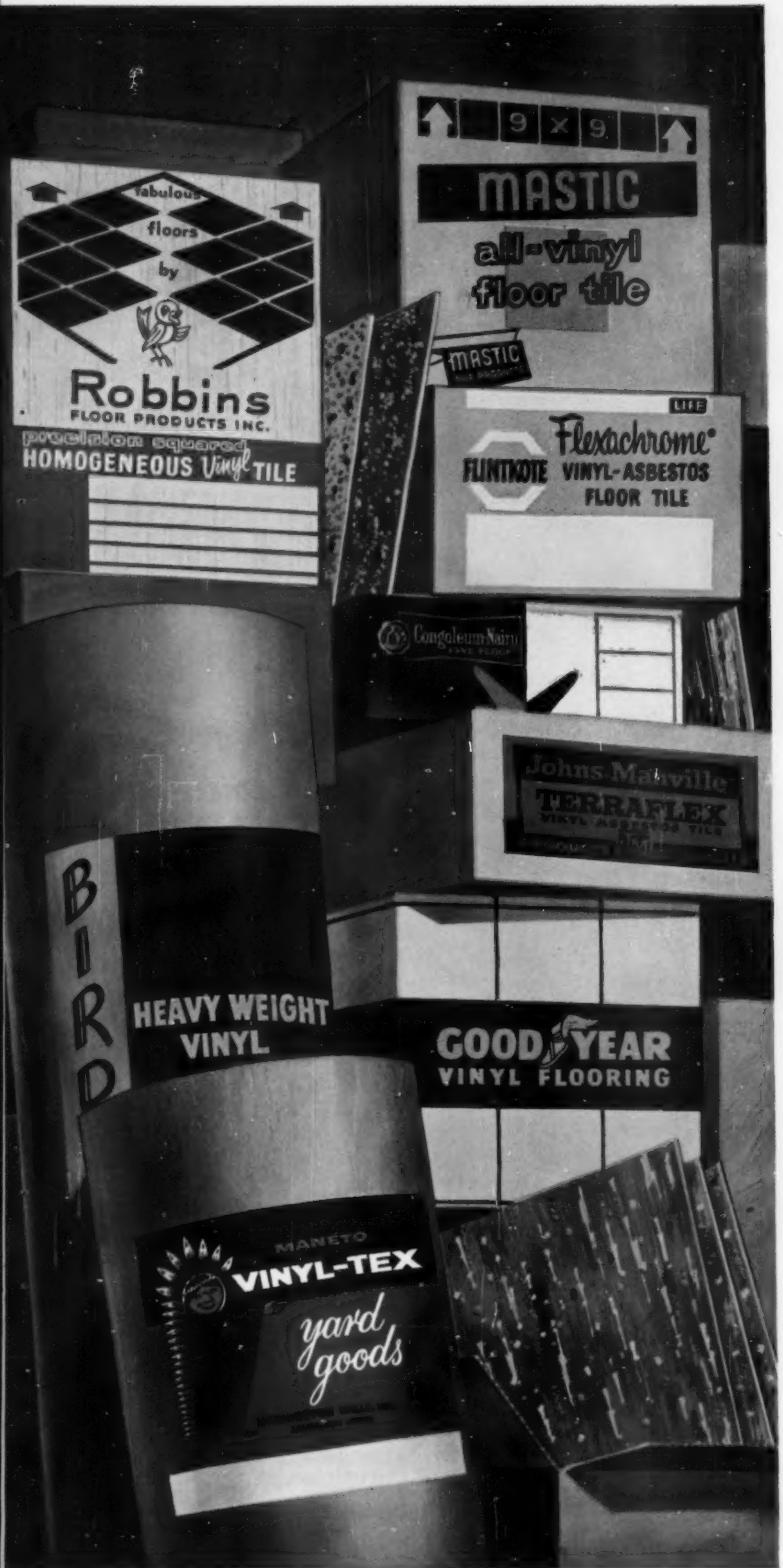
Obviously, at this size run, powder molding is more economical.

But suppose the run is doubled. At 12,000 pieces, the injection mold is amortized by adding $1.50 to the cost of each piece, for a total piece price of $2.78. Now injection molding is the more economical process. In this particular case, the crossover point is actually at about 8820 pieces. (This number will vary from application to application.)

Properties: As mentioned above where good stress crack resistance is required, in large pieces, the low M.I. resins used in powder molding offer a definite advantage. In addition, the fact that no pressures are involved (outside of the weight of the material itself), results in strain-free moldings. One processor states that because of this fact he can now guarantee his products for use at 200° F. under no load conditions.

There is also the matter of impact strength. With injection-molded pieces, orientation of the molecules around the gate area represent an impact problem in a product, which does not exist in powder molding.

Wall thickness and tolerance: There are both upper and lower limits of wall thickness in powder molding. The lower limit is about 1/16 inch. With a thinner section, there may be danger of pinholes. The upper limit is about 3/8 in., because of reduced heat-transfer and because beyond that there is a tendency to sag, even at the low melt indexes involved. Wall thickness tolerances are generally on the order of ±10%, which compares to ±5% for sheet forming and ±3% for injection molding.—**End**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FLINTKOTE VINYL-ASBESTOS
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Johns-Manville
TERRAFLEX
BIRD
HEAVY WEIGHT
VINYL
GOOD YEAR
VINYL FLOORING
MANETO
VINYL-TEX
yard
goods

Jetliner wing

(From pp. 84-85)

that the elasticity could be obtained from five plies of epoxy-impregnated glass cloth cured under vacuum and autoclave pressure.

Modulus "control" is achieved by the manner in which the plies are laid up. The first, third, and fifth plies are Style 181 cloth, laid parallel to the panel face. The second and fourth plies are Style 182 fabric, with its warp direction running at 45° to the warp direction of the other plies. These 45° plies provide the necessary control in building laminates of exact thickness and compressive modulus.

Production of RP panels

The Boeing fabrication process starts with rolls of the self-extinguishing epoxy-impregnated glass cloth. Shipped by refrigerated truck from the suppliers, the rolls are placed in a refrigeration room and kept at 35 to 45° F. if storage period is to exceed 21 days.

The prepreg is unrolled onto cutting tables where it is cut with razor knives to approximate dimensions. In the case of the skins, the prepreg plies are laid on a flat caul plate covered with a layer of PVA film. After the five prepreg plies have been assembled, a layer of perforated PVA film is laid over the entire surface, and a ply of glass fabric bleeder is placed over it. The unit is then covered with a caul plate which has been coated with a parting agent. No effort is made to buckle the caul plates together, nor are guide pins used to orient one onto the other.

The complete unit is cured under vacuum blanket in an autoclave. Cure pressure includes both vacuum pressure from the bag and a positive 100-p.s.i. pressure from the autoclave. Cure temperature is 275° F., for 1 hour. After partial cooling, the parts are removed from the mold and are post-cured at 390 to 410° F. for 3 hours.

Matched metal dies are meanwhile used to fabricate hat-section stiffeners and angle strips of a laminate format almost identical to that of the skins. Again, the parts are constructed from five separate plies of prepreg, with the second and fourth plies cut on a bias. The resulting part thickness, 0.05±

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0.005 in., is uniform throughout the skins and hat-section stiffeners except at overlaps in the Style 182 fabric. Molded splice blocks of prepreg are used to close out the ends of the stiffeners and to reinforce the fastening strip along the panel edges. Design of hat-section stiffeners includes a broad flange on both sides, with the result that the stiffeners, when assembled on the under side of the panel skins, nearly butt each other. A continuous sheet of adhesive is therefore used to bond the stiffeners to the skin. A prime coat is used on all surfaces to be bonded. A supported epoxy-nitrile tape is then laid in place. The hat-section stiffeners, angles, and splice blocks are assembled in a bonding tool which is designed to apply bonding pressure on the contact surfaces only. Again, a combination of vacuum and autoclave pressure is used. Cure, at 50 p.s.i., consists of 325 to 350° F. for 1 hour.

When the 10 RP panels are bolted and riveted together in an assembly jig, they form a pairing which is a unitized section, ready to be assembled on the Boeing 720 wing. The leading edge of the plastic section merges smoothly with the aluminum leading edge structure. The trailing edge of the plastic section, however, is bolted on top of the aluminum skin that forms the rear portion of the wing surface. The resulting discontinuity is corrected by a row of phenolic fairing blocks which have been machined so that they taper from a thickness of ½ in., where they butt against the reinforced plastic panels, to a knife edge.

Final step in the assembly of the plastic wing sections is the application of an electrically conductive coating which prevents the building up of static charges on the isolated plastic sections.

Both the size of the plastic panel sections and the aerodynamic role that they serve prove again that reinforced plastics have earned their place in the design and assembly of structures for high-performance aircraft.

Credits: Epoxy-impregnated glass cloth supplied by Coast Mfg. and Supply Co., Livermore, Calif., and U. S. Polymeric Chemical Inc., Santa Ana, Calif.; adhesives for panels by Bloomingdale Rubber Co., Aberdeen, Md.; adhesive for fairing blocks by Thiokol Chemical Corp.—**End**

Polypropylene

(From pp. 85-88)

This feature permits easy finger-tip removal of the test tube racks from their high-impact polystyrene case, yet locks them securely into the case in drawer fashion when not in use. Each rack has split-ring retainers to hold nine standard 16-mm. test tubes. And because of the material's "plastic memory," each of the test tubes is held so firmly in its retainer that it cannot be dislodged when the rack is turned upside down for emptying, and yet each tube can be manually shifted or turned under the microscope.

The racks rest in the case at a 3-degree angle in order to provide for proper bathing of test cells in the culture media. In addition to this, the entire rack and case design is such that a maximum of air space is provided to assure proper tissue culture incubation.

At a weight of about 2⅔ oz. each, the PP test tube racks total approximately 1 lb. in the complete test tube handling unit, since six racks are contained in each case. Therefore, the potential market foreseen for these units—25 to 30,000 per year—in turn represents a hefty potential market for polypropylene resin.

The test tube racks are molded by Philadelphia Plastics & Mfg. Co., Philadelphia, which uses single-cavity molds on an 8-oz. De Mattia machine. Cycle time is approximately 20 seconds. Material used for this application is supplied by Hercules Powder Co. Inc., Wilmington, Del. The polystyrene cases are molded in single-cavity molds on a 12-oz. De Mattia machine, using material that is furnished by The Dow Chemical Co., Midland, Mich.

The polypropylene applications studied in this article have their potential in markets that are far from being static; inherent in all three product areas is vast future growth. And while it would be wishful thinking to visualize these markets in terms of 100 million lb. plus for polypropylene, a truly realistic view would be that this material, with its excellent economic, property, and design factors, will someday capture the major share of the total potential poundage in these markets.—**End.**

Light diffuser

(From page 89)

they can be installed as is or, as is more often the case, a ⅜- to a ½-in. hole can be punched through at the center of each of the depressed circular areas. This, in essence, effects an open construction that means that the light diffuser panels can be installed under a sprinkler system. In addition, the apertures permit air to circulate freely through the plenum, reduce dust and insect accumulation, and facilitate washing of the panels.

The apertures perform a unique function in that they are spaced far enough apart to minimize the "see-through" usually expected in open-type panels, yet because they are essentially inverted cone openings, they produce a direct light shielding of at least 45° in all directions. In a typical luminous ceiling application, the panels provided a transmission efficiency of 86%, 150 ft.-candle level illumination, and a brightness ratio never exceeding 5:1.

Nor do the apertures affect the rigidity of the panel in any way. A 2 by 2 ft. or a 2 by 4 ft. panel, ½-in. thick, in open construction, can still be supported by its edges without sagging.

The panels are light in weight—a panel 2 ft. sq., ½ in. deep, weighs 32½ ounces. The panels are approved by Underwriters' Laboratories with a flame spread rating of 20. Because vinyl is the material of construction, a choice of translucencies is available to the designer to achieve maximum visual comfort when high light intensities may be involved. The unique cellular construction has an added advantage in breaking up and dispersing sound waves.

Attesting to the construction's versatility, architects and designers are already evaluating its use for wall partitions, as a vision barrier, for display applications, and for use in radio and TV sets as sliding door arrangements. Designers are also experimenting with three-dimensional shapes other than the conventional circular depressions.

Credits: Circlgrids are produced by Cirvac Plastics, a Div. of The Wilson Research Corp., Erie, Pa., using vinyl sheet supplied by Union Carbide Plastics Co.—**End**

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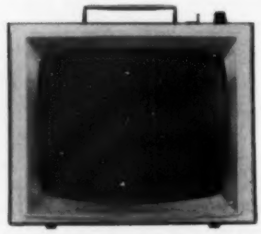

GENERAL ELECTRIC parts molded of TMD 5161 by Buffalo Molded Plastics, Inc.; Plastic Inlays, Inc.

PHILCO parts molded of TMD 5161 by Champion Molded Plastics, Inc.; Buffalo Molded Plastics, Inc.; St. Regis Paper Company.

SYLVANIA parts molded of TMD 5161 by Buffalo Molded Plastics, Inc.; Presque Isle Plastics Inc.; Plastic Inlays, Inc.; St. Regis Paper Co.

WESTINGHOUSE parts molded of TMD 5161 by Plastic-Ware, Inc.; St. Regis Paper Co.

WARWICK (Sears-Roebuck) parts molded of TMD 5161 by Sinko Mfg. Co.; General American Transportation Corp.; Amos Molded Plastics; Plastic-Ware, Inc.


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Styrene beads

(From pp. 92-93)

type customarily used in shoe construction. Such heels may either be covered, as is done with wooden heels, or they may be painted with various types of finishes to obtain a patent leather or any other desired effects.

Construction. In tests, slabs of the material measuring 1½ in. by 4 by 8 ft. have been molded in approximately 20 sec. using the steam probe method. These slabs, which are manufactured in a density of 6 lb. per cu. ft., weighed less than 40 lb. each, as compared to 107 lb. for a piece of fir plywood of similar size that measured only 1⅛ in. thick.

The molding of building panels of a type now in production requires that facings of plywood or other materials be bonded directly to the foam core at the time it is being molded or expanded. Heat-curing adhesives are used for this operation. With the coated beads, panels could be made with an integral skin, requiring no additional surfacing material. Also, exterior surfaces might be molded to simulate shingling or some other desired architectural treatment. Color could be molded in, or, of course, the panels could be painted on both sides if necessary.

Electrical conduits, piping, and similar appurtenances could be molded directly into the panels, eliminating or greatly reducing on-site fabrication.

Ceiling and wall tiles are other logical construction uses where this material could prove useful, inasmuch as it combines a resilient, sound-absorbent core as well as a hard, insulating, decorative surface that has proved resistant to abrasion and staining.

Refrigeration. This field is expected to make extensive use of the new coated expandable beads. In contrast to conventional construction methods, in which glass wool, plastic foams, or other types of insulation are sandwiched between the inner and outer cabinet shells, with the new expandable styrene material it is possible to hold large components as one-piece units having their own built-in insulation and integral skin.

Perhaps the concept of the all-plastic refrigerator, molded in two components—a cabinet and a door of insulating materials—is now closer to reality than anyone might have believed.

It should be pointed out that because of the higher densities required, it has not been fully established whether the thermal conductivity of components that are molded of the coated styrene beads would be equal to that which is obtained with conventional molded styrene foam.

However, considering the overall properties of this new material, its insulation efficiency is still good enough to permit entirely new design concepts of refrigerator construction.

Housewares. During the past couple of years, manufacturers of ice buckets, thermal jugs, picnic coolers, and related products have turned almost exclusively to molded expandable styrene foam for their insulating material. However, in order to protect the relatively soft surface of the foam material, many such products are surfaced with an outer (and sometimes an inner) shell of linear polyethylene or other molded or formed material. With the new coated beads, however, a picnic cooler may now be molded with an integral, abrasion-resistant, dent-proof skin on both the inner and the outer surfaces.

Miscellaneous. Among the many other items which have been molded of this material are insulating covers for pre-cooked foods, packaging components for products such as photographic equipment, a travel kit for shoe care, wheel hubs for hand truck wheels, a float for a muriatic acid tank, decorative name plaques, shotgun wads, air rifle pellets, toys and toy components, small gears, and an 11-ft. sailboat hull.

Many types of floating toys, which normally are subjected to considerable abuse by their users, appear to be logical applications for the material.

Credits. Plastisol-coated beads: Kenolite (trademark registered, U. S. Pat. pending) developed by Fred Sohr Jr., produced by Keno Plastic Processing Corp., Milwaukee, Wis.; vinyl coating supplied by Watson-Standard Co., Pittsburgh, Pa.; styrene beads by Dow Chemical Co., Midland, Mich.; and Koppers Co. Inc., Pittsburgh.—**End**

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"Well, first I went over his order form again to be absolutely certain that it was correctly entered, then throwing the old maxim that *the customer is always right* to the wind, I got his purchasing agent on the phone.

"Now, who ever says purchasing agents, by and large, can be a stern lot, hasn't talked to this one. Turned out it was an error—a double-up order for which he had neither immediate use nor storage capacity. Upon his advice I post-dated the order three weeks and thanked him for his very kind words about our service.

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German car

(From page 96)

Polyethylene goes into several important components. Molded low-density protective bases are used under exterior door buttons and handles to prevent the metal parts from contacting and edging into the painted car body. PE is used as a dielectric for the connection between distributor coil and distributor and from distributor to spark plugs. The PE part is said to end spark radio interference.

Containers for the windshield washing system and brake fluid are blow molded of transparent high-density PE. The exterior shell of a hose that conveys hot air from the engine to the body is also blow molded of PE in a bellows construction that can expand and contract. In addition to the shell, there is a supporting interior cage molded of polypropylene in an open spiral pattern; fiber wadding which helps to absorb noise is placed between the two parts. Because of its construction, the hose is flexible enough to absorb the vibrations that take place during travel. And the PP cage can easily take the temperatures encountered, up to 125° C.

Another interesting polypropylene part is a molded shim used between the gear case and the spherical cap of the rear axle halves. The shim is designed to increase the working life of the gear housing by taking up pressures and contact with hot oil.

Polycarbonate has also found a place in the Volkswagen in the form of a transparent housing for a fuse box. Nylon is put to use in the design of rollers for the sliding roof, a cemented two-part carburetor float, and catch pins for the seat-shifting device.

Urethane foam, in addition to its use as backing for door panels, sun visors, and upholstery, goes into supports for the fuel tank and brake-oil containers and into acoustical insulation.

Phenolic bushings for the axle (with 50% filler of chemically-treated cellulose fibers), acrylic blinker lights, dome lights, and license plate frames, urea and butyrate buttons are also listed among the more than 100 plastics parts that are going into today's Volkswagen.—**End**

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Selecting sheet

(*From pp. 97-99*)

skills, which most custom extruders have at their disposal. Anyone can learn them, but it takes time, and costs money in terms of poorer product or higher scrap costs until these skills are developed.

Responsibility. Who would sales and quality-control departments rather deal with—their own production people, or an outside vendor? The answer to this query could go either way!

Storage and space. Captive extrusion requires space for the machine, office space for supervisors, and storage for raw materials.

Cost savings. The custom extruder is in business to make a profit, and this is saved by captive extrusion. Shipping costs are saved, too —not only of sheet, but also of thermoforming trim, which must be reground. It is resold at a loss, which is saved by captive operation. These savings amount to between 5¢ and 15¢ per pound.

Control. The end-user has better control of his supply—raw materials, schedules, delivery, troubleshooting—if he makes his sheet.

Most of the expenses of a captive operation are in start-up; most of the savings are continuous. Thus the decision is one of volume. Do we expect to extrude enough pounds to pay off the machine and related costs in a reasonable time? And if so, is the overall savings the best return we can get with this money, as an investment?

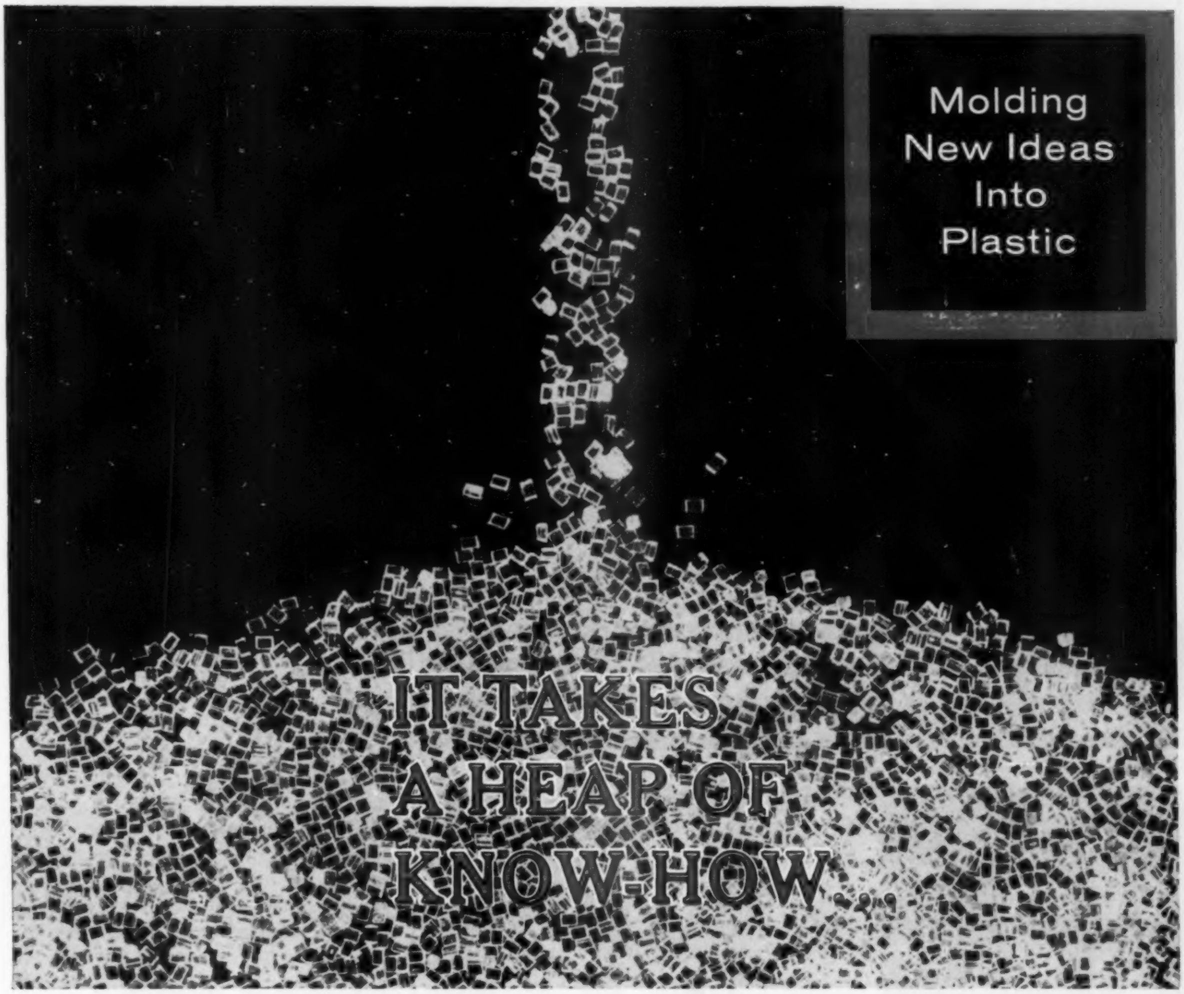
Typical direct operating costs of extrusion vary from 2¢ to 5¢/lb., including amortization of equipment, but not including building, sales expense, and other overhead.

Assuming a captive operation, and the production of the hypothetical carton, a method of arriving at a cost breakdown for investment is shown in Table II, p. 98.

6. How many parts are needed? What equipment will be used?

To answer these questions, an estimate is needed of expected sales, and the engineers must decide whether or not to thermoform in line with the extruder, and what type of machinery is needed.

Making the necessary assumptions in Table II, it is found that \$140,500 is needed for the invest-



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ment. Using this figure in Table III and figuring 5 years to return this investment, cost of amortization per part is found, and included in the total direct cost of processing per part, or per 100 parts. For the carton, this is $0.333 per hundred.

7. What is the material cost per part, for each material given in answer to Question 3?

Under Question 3, we selected plastics based on the properties required to do the job. One way of calculating cost per part for each plastic material would be to choose an optimum design for each material and calculate from that. Another way would be to select a design that has been fixed, except possibly for thickness. In the latter case, the major cost variable among materials, other than raw material cost, will be thickness.

Some plastics, more expensive per pound than others, may actually be cheaper per part, because they require thinner walls. In this regard, it is important to determine what is the limiting factor for thickness. Ask the question "what will happen if we make it 5% thinner?" The answer, usually, is either insufficient toughness or rigidity. If toughness is the limit, a thinner wall of a tougher material may be cheaper in the long run. If rigidity is the limit, a stiffer material may save money. Also, part design should be reviewed, as rigidity can often be added without sacrificing much else.

Comparison of toughness is best done with practical tests on the finished object, although for heavy sections the Izod notched test on *extruded sheet* is useful. Be cautious of advertisements quoting injection-molded values for extrusion materials. These oriented molded bars yield deceptively high values, which do not hold true in the final extruded piece.

Comparison of rigidity is best done on finished parts, but modulus data are useful, too. The nomograph in Fig. 1, p. 99, will tell what change in thickness is needed to keep the same rigidity, for a given modulus change. Connect the known modulus and sheet thickness with a straight line. Then, draw another line through the new modulus and the place where the first line crossed the reference line. The

newly-drawn line will then pass through the new thickness. This nomograph is accurate enough for most calculations; for maximum accuracy, use its equation, as noted at the bottom.

For example; if polyethylene at 150,000 p.s.i. will do a good job at 0.040 in., what thickness of impact polystyrene (33,000 p.s.i.) will be just as rigid? The method of finding the answer is illustrated in Fig. 1 and explained in the caption accompanying it.

For the container, where rigidity limits thickness, assume that the optimum *sheet* thickness for super-impact polystyrene is found to be 50 mils. Then, using Fig. 1, the optimum sheet thickness for all three materials is:

0.96-density polyethelene	0.055 in.
Polypropylene	0.054 in.
Super-impact polystyrene	0.050 in.

Material costs, then, at May 1961 prices, are as follows, assuming 10 cartons per pound of super-impact polystyrene:

0.96-density polyethylene	\$3.57/100 parts
Polypropylene	\$3.96/100 parts
Super-impact polystyrene	\$3.50/100 parts

These costs do not include costs of scrap rehandling.

8. What are additional costs per part?

Most of these will be the same for all materials. Include here costs of handling scrap, development costs, sales costs, and other overhead as customary. Table III includes these, and adds up total costs as:

0.96-density polyethylene	\$4.05/100 parts
Polypropylene	\$4.44/100 parts
Super-impact polystyrene	\$3.98/100 parts

Weigh costs against properties

For this example, the super-impact polystyrene comes out as lowest in cost. Go back to the answer to Question 3—is there any reason to prefer the other two? The reasons, if any, should have been written out, ready to be weighed against the cost differences.

The decision is then made and justified.—**End**

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EQUIPMENT • SUPPLIES • SERVICES

ADHESIVES. March issue of company's adhesives publication discusses role of adhesives research in maintenance of utility standards, "specification adhesives", and gives guide to adhesive properties. The Arabol Mfg. Co. (101-G)

POLYESTER RESIN. Technical 12-page illustrated booklet describes the characteristics, fabricating procedures and end uses of 24 standard "Laminac" formulations. Resins are grouped by performance. Plastics & Resins Div., American Cyanamid Co. (102-G)

POLYETHYLENE RESINS. 22-page booklet gives detailed physical and chemical characteristics of 17 types of "Riblene" polyethylene resins. Types and uses, with illustrations of end use also given. A.B.C.D., Petrochemical Dept. (103-G)

MOTORS. 8-page bulletin outlines extensive line of electric motors to meet a broad field of application requirements. 23 types of motors with descriptions and application uses and available ratings enclosures and modifications are covered. Louis Allis Co. (104-G)

PROTECTIVE LININGS. 49-page test chart manual is designed to help steel container users, manufacturers and reconditioners select proper protective linings. Describes each of this company's linings in detail, outlines test program and explains the company's evaluation system. Bradley & Vrooman Co. (105-G)

NYLON RESINS. 32-page brochure gives complete physical and chemical properties of line of linear polyamide plastics. Includes polyamides for processing by injection molding, extrusion, in solution form and by special processes, for a wide variety of applications. Badische Anilin-& Soda-Fabrik AG. (106-G)

CUSTOM MOLDING. 4-page brochure lists facilities available, including design, mold making and tool room, molding equipment. Brilhart Plastics Corp. (107-G)

INJECTION MOLDING MACHINES. 12-page folder describes two models of automatic plastic injection molding machines. Schematic diagrams and production data, general data given. Buhler Brothers Engineering Works. (108-G)

PLASTICS MACHINERY. Illustrated data sheet covers 5 granulating machines, pelletizer and dicing machine. Pictures, specifications, general information given. Cumberland Engineering Co., Inc. (109-G)

SURFACE PYROMETERS. 12-page booklet gives illustrations, specifications, ranges of roll, extension, mold, needle, and surface pyrometers. Cambridge Instrument Co., Inc. (110-G)

PEARL ESSENCE. 12-page booklet discusses definition and uses of pearl essence. Samples of paper coated with pearl in casein solution, cellulose acetate sheet pigmented with pearl essence, cellulose nitrate sheets pigmented with pearl, and methyl methacrylate button blanks pigmented with pearl included. Crystal Essence Corp. (111-G)

TEMPERATURE INDICATOR. Folder and application bulletins on "Detecto-Temp" temperature indicating paints and crayons which change color on reaching specific temperatures. For use in materials processing. Curtiss Wright, Princeton Div. (112-G)

EXPANDABLE POLYSTYRENE. 4-page folder describes company's three-fold services using expandable polystyrenes: product design, mold design, production. Applications include packaging, marine products, insulation, toys, novelties, furniture, etc. Expandex Corp. (113-G)

COLORING FOR PLASTICS. 3-page data sheet describes dry coloring granular thermoplastics resins with line of non-dusting powdered pigments. Advantages are: almost unlimited range of color, flexibility, eliminates waste. Color Div., Ferro Corp. (114-G)

FREQUENCY DEVIATION RECORDS. 4-page bulletin describes trip recorders and round chart recorders for use in recording and indicating any deviations from a predetermined frequency. Information on applications, accuracy, response, chart speeds, etc., included. General Electric Co. (115-G)

PRINTING & DECORATING POLYETHYLENE. 16-page illustrated booklet is designed to be comprehensive summary covering variations in decorating techniques for both treated and untreated low and high density polyethylenes. Appendix also lists 250 sources for services, equipment and supplies mentioned in booklet. W. R. Grace & Co., Polymer Chemicals Div. (116-G)

FLUORESCENT WHITENING AGENT. 2 data sheets describe properties of brightening agent. Uses include the whitening and brightening of plastics, coatings, synthetic fibers, waxes, and other organics. Geigy Industrial Chemicals. (117-G)

STOCK CYLINDER ADAPTERS. Data sheet describes and gives schematic diagram of heating cylinder adapter to permit interchange of standardized cylinders between old and new machines. Injection Moldrs Supply Co. (118-G)

POLYESTER. Two charts for computation of additives for polyesters are included with a flyer on polyester gel coats. Gel coats are said to have lasting and brilliant color, long term durability under sun, freedom from underwater cracking, high resistance to impact and abrasion. Interchemical Corp., Finishes Div. (119-G)

INJECTION MOLDING. 20-page booklet gives trouble-shooting check list to aid in diagnosis and solution of some common problems encountered in the injection molding of polystyrene in its various types. Koppers Co., Chemical Div. (120-G)

WIRE ASSEMBLY. Folder discloses technical advantages of letter-numeral marking for code identification o electrical wire harnesses and illustrates hand operated, motor driven and air operated wire and tube marking machines. Kingsley Machine Co. (121-G)

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GEL-TIME METER. Illustrated folder describes meter that automatically measures the gel time of all thermo-setting resins. Stops automatically when gel time is reached, records time, signals completion of test. Applications, features, specifications. American Petrochemical Corporation, Mol-Rez Div. (137-G)

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PLASTICS WELDING INFORMATION. 4-page illustrated manual contains operating and maintenance instructions for equipment used in welding thermoplastics such as polyethylene, polypropylene, rigid and plasticized PVC, etc. Kamweld Products Co. (141-G)

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How to hot hob

(From pp. 101-111)

greatest advantages of hot hobbed beryllium cavities or cores is the lesser force required in the hobbing operation. This means that there is considerably less chance of damaging the hob, and that delicate, asymmetrical and built-up hobs that were previously impractical can now be used safely.

In addition, the cavity reproduces the "reverse image" of the hob much more faithfully so that the problem of cavity walls moving away from the hob is at a minimum. Where a convex mold surface is required, such as a case in which the hob is concave, there is little difficulty encountered in making the metal of the cavity flow upward into the hob and into the shape that is desired.

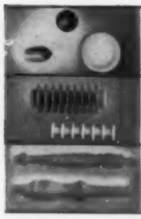
Another advantage is that the overall size of hot hobbings can be made smaller so that there is less metal to be removed from the outside of the cavity.

Hot hobbing involves more than merely placing the hob in the chase, casting beryllium copper over it and then applying a predetermined amount of pressure. One must know the exact temperature of the hob, chase, and molten metal and considerable care should be taken to guard against overloading the hob.

Hot hobbing is not like a machine tool operation where the work is constantly in view. When the metal is poured over the hob in the chase and pressure applied it is impossible to see what is taking place. The results can only be known when the hob is removed from the impression. It only takes a few seconds in a hydraulic press to ruin a hob on which many hours and many dollars have been spent. When hot hobbing of beryllium copper is being considered it is wise to consult a good hobber even before designing and making the master steel hob.

Acknowledgments

The author wishes to acknowledge the assistance of the Beryllium Corp. and the Newark Die Hobbing & Casting Co. in providing a great deal of the background material that was used in illustrating this article.—**End**



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NATCO SCREW-RAM

NATIONAL AUTOMATIC TOOL COMPANY, INC.
PLASTICS MACHINERY DIVISION
RICHMOND, INDIANA

Automated system

(From page 117)

load to carry repeatedly through an 8-hr. day.

The problem involved was obvious. Some processing method was required which would eliminate the heavy labor required and which would preferably increase the rate of preform production. After due consideration it was decided that the best approach was the development of new equipment. Accordingly, it was designed.

Preform production rate with the new installation is twice that of the previous method; for example, 250 of the laundry tub preforms pictured in Fig. 1, p. 117, can be produced per 8-hr. day as opposed to 125 with the old method. A better product is obtained insofar as both curing and shape retention are concerned.

Heavy manual labor is eliminated. The only time the preform screens are handled is when they are set in place on the four-door surfaces. Once in place, the screens remain there as long as preforms of that size and shape are being made. The screens are of 3/16-in.-thick perforated steel and are mounted on standard-size base plates which, in turn, are fastened to the steel work wheels. The complete installation takes up a space in a corner of the plant that is only 11 ft. square.

Production cycle

Making the fibrous glass into preforms and curing the acrylic binder are all part of one continuous operation, divided into four stages: 1) application of fibrous glass-binder combination; 2) solvent evaporation and partial first cure at 325° F. in the first heating zone; 3) completion of curing, also at 325° F., in the second heating zone; and 4) removal of the cured preform at the unload station. The time required for the job from start to finish varies according to the preforms being made; it takes only 4 min. on the average (1 min. per stage). To produce the laundry tubs pictured in Fig. 1 requires a total of 6 min., or about 1½ min. in each stage.

Through the day (except for initial start-up and final shut-down) every station remains in productive

use. This is possible because each of the four surfaces of the "revolving door" or turntable assembly are identical in all respects. A plan view of the preformer is shown in Fig. 2, p. 117.

At the application station, the operator shoots the shredded fibrous glass and acrylic binder combination onto the metal screen form, which is sized and shaped according to the finish preform desired. At this station, the work table on which the screen is mounted automatically rotates so that the fibrous glass mixture can easily be sprayed uniformly over the entire form. The time that is required to do this is 1 min. or less, depending upon preform size, and the amount of material applied. Quantity of material is regulated by an automatic shut-off on the gun. At present, preforms of thicknesses up to ⅛ in. are being laid down, although greater thicknesses could be applied if necessary. When this step is completed, the operator trips a foot pedal that actuates the main turntable mechanism. The preform is advanced to the first heating zone in the oven.

In the meantime, the helper at the unloading station has removed a cured preform and cleaned excess fibrous glass from around the screen at this position. When the main turntable is actuated by the operator, this station, of course, automatically swings to the application station. (See Fig. 1.)

The process is continuous so that there are always two preforms in the oven at the same time that a finished preform is being removed and a new one being applied. (See Fig. 2.)

Quality of the preforms is high because of the provisions made for good shape retention. At the application station, a 9000-cu.-ft./min. fan creates suction on the metal screen form so that the mixture being sprayed on is held firmly in the desired shape. When the preform travels into the oven, a 3500-cu.-ft./min. oven fan directs 325° F. air on the part so that the preform remains tightly around the screen as it is being cured. Even distribution of heat at a constant velocity assures complete curing.

The system was engineered and built by The W. W. Sly Mfg. Co., Cleveland, Ohio.—**End**

"Maybe this 132 years of plastics know-how can help solve <u>your</u> appliance molding problem," says Joe Foster.

Ignition temperatures

(From pp. 119-122)

from the "A" series that gives the lowest flash temperature and repeat the appropriate section (A-1, A-2, or A-3) using a temperature rise of 300° C./hr. (±10%).

D. Second approximation of self-ignition temperature. Choose the air-flow setting from the "B" series that gives the lowest self-ignition temperature and repeat using a temperature rise of 300° C./hr. (±10%).

E. Constant temperature tests to determine minimum ignition temperatures.

Note 2: The air temperature of ignition in the constant temperature tests is taken with the specimen thermocouple (T_1) before the specimen is admitted. The air-temperature thermocouple (T_2) in these runs simply records whether the furnace is running under constant conditions during the test.

1. Minimum flash-ignition temperature.

a. Start furnace with the air-flow setting used in "C". Adjust the variac setting until the initial air temperature (T_1) stays constant as indicated by the recorded temperature readings for a 15-min. period. The initial temperature should be not more than 10° C. below the flash temperature found in "C".

b. Place specimen in furnace, ignite pilot, and watch for ignition.

c. If ignition occurs, repeat the test with the temperature (T_1) maintained at a 10° C. lower setting. Repeat at lower temperatures until there is no ignition in 30 minutes. When the temperature (T_1) is reached at which no ignition occurs, a second run should be made to see that this is below the self-ignition temperature.

d. The lowest *air-temperature* setting at which ignition occurred is reported as the minimum flash-ignition temperature.

2. Minimum self-ignition temperature.

a. Repeat same procedure as "E-1" without the pilot. Start with the air temperature 10° C. lower than the temperature found in "D".

Note 3: If no ignition point was found in "B" or "D", test "E-2" should be started with a constant air temperature about 100° C. above the flash temperature found in "C". This is because some plastics (for example, polystyrene) boil away before self-ignition takes place during the rising temperature test. A self-ignition point can be found in the constant temperature test if the initial temperature is high enough. The air-flow rate for this test should be the same as in "C".

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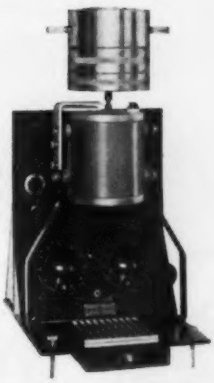

Urethane polymers

(From pp. 125-127)

curing agent was degassed in a vacuum, poured into open-faced slab and button molds which had been heated to 220° F. The liquid resin was again degassed by vacuum and cured in a forced draft oven at 200° F. for 6 to 24 hr., depending upon the diisocyanate used in the prepolymer preparation.

The cured polymers were tested for both physical and electrical properties. The physical tests (Table IV, p. 126) included hardness, compression set, tear resistance, tensile strength, ultimate elongation, and low temperature brittle point. Electrical determinations (Table V) were volume resistivity, surface resistivity, insulation resistance, and dielectric strength.

Structure versus properties

Several correlations between molecular structure and physical properties of the cured materials were noted. The relationship of the structure of the diisocyanate used in the prepolymer preparation to tear resistance, tensile strength, and ultimate elongation was of particular interest. As shown in Table VI, p. 127), both diphenylmethane diisocyanate and dimethyldiphenyl diisocyanate based materials showed a marked increase in the aforementioned properties over similar polymers made with toluene diisocyanate. The diaromatic diisocyanates also increased the hardness of the cured polymers. Along with this increase in hardness was an increase in compression set values. Diphenylmethane diisocyanate prepolymers had the highest compression set values and toluene diisocyanate materials the lowest.

The low temperature brittle point also seemed to vary with the type of diisocyanate used in the prepolymer preparation. Both toluene diisocyanate and diphenylmethane diisocyanate polymers showed desirable low temperature properties, with the latter having somewhat lower values. The dimethyldiphenyl diisocyanate molecule gave materials of higher brittle point temperature.

Only slight difference in the physical properties was observed between the various polyester-based polymers prepared with the same diisocyanates, as illustrated in Table VII, p. 127. An exception to this was a polymer made with 1,4-butanediol-adipic acid polyester and toluene diisocyanate, which displayed greater tensile strength and tear resistance than any other toluene diisocyanate based material. Polymers which were prepared from diethylene glycol-adipic acid polyesters, however, displayed the poorest low temperature properties of all.

The electrical properties of the various polymers could be classified as good, with no significant differences being noted.

The authors wish to express their appreciation to J. Daly for supervising the preparation of the test specimens; to R. Bruce for his support of the program; to O. Krueger and E. Slagel for preparing both the polyester and prepolymers; and to the Bendix Corp., Kansas City Division, for granting us permission to publish this article.—**End**

Straining behavior

(From pp. 129-133)

dissociation temperature of secondary bonds has no orientation in structure, and so, of course, there is no strain recovery after it is annealed. Thus, linear polymers worked at a sufficiently high temperature are in a stable state; hence, it is desirable to perform plastic working such as injection, drawing, etc., of linear polymers in the hot state, not only because of stability of structure but also because of better workability (9).

Fundamental strain characteristics of high polymers may be classified into intramolecular micro-Brownian motion (deformation strain) and intermolecular macro-Brownian motion (flow strain). This is analogous to classification of the wide distribution of relaxation spectra at room temperature into "wedge type" and "box type" (7). The former has a short relaxation time and the latter a long relaxation time. They are considered to correspond to deformation strain and flow strain, respectively. An increase in the plasticizer concentration brings about an intrinsic change in relaxation spectra of polymers. The effects of factors such as rate of strain, magnitude of working strain, etc., are not caused by intrinsic change of spectra, but by the part of the continuous spectra that is predominantly influenced.

The author wishes to thank Dr. K. Kaneshige, Dr. S. Fukui, and Dr. S. Watanabe, professors of Tokyo University, and Dr. K. Arai, Japan Society of High Polymers, for their kind advice.

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THE PLASTISCOPE*

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By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 39)*

July 1961

Gulf spotlights petroleum-plastics tie-in

When Gulf Oil Corp. recently announced the construction of a multi-million-dollar benzene-cumene complex at Philadelphia, attention was focused on the petroleum industry and paritcularly Gulf Oil's contribution to raw materials for use in the plastics industry.

Way back in October 1947, MODERN PLASTICS printed a long article entitled "Must Plastics Depend on Coal?" which pointed out that the plastics industry must have more benzene if it was to expand as expected. Benzene was then available only from coking operations in steel production and tar distillers. It was obvious there wouldn't be enough to supply the growing needs for the manufacture of phenol and styrene used by producers of phenolics, polystyrene, and nylon together with other products. The shortage of styrene and phenol during the Korean war emphasized this situation. At that time petroleum companies could not produce benzene at a price that would compete with benzene from coke ovens. Since that time a lot of water has gone over the dam. The sales price of benzene from petroleum has been reduced to that of coke oven benzene—it has become one of the leaders in the petroleum company parade of the now highly publicized petrochemical products.

But even with petroleum companies producing more than coke oven operators, the benzene supply in 1960 was barely enough to keep up with demand. Around 310 million gal. were produced by petroleum companies, 136 million by coke ovens, and 10 or 12 million by tar distillers. In addition, some 38 million gal. were imported. But new capacity from petroleum and expanded steel operation will bring capacity to over 700 million gal. in 1961 (over 200 million gal. more than 1960 consumption), and thus permit rebuilding of inventories. Sometime around 1962 there will probably be over-capacity.

Gulf alone supplied 30 million gal. in 1960 and the new plant will add more when it comes into production early in 1962. However, a large portion of the new benzene will be used to supply raw material for the cumene facility which is to be built alongside the benzene plant. Cumene is used to make phenol and acetone by a comparatively new process. At present there are only three or four such facilities in the United States. The cumene process for producing phenol is said to be more economical than the older methods but the problem is to dispose of the acetone in a declining market. A spokesman for Gulf said the company expected to sell a great portion of the cumene to European countries and thus help to improve the U. S. export situation, which has been on the decline. In Europe the cumene will be converted to phenol where a great portion will supposedly be used for caprolactam.

The phenol distribution in the U.S. is estimated to be about as follows: 370 million lb. for plastics; 300 million for chemicals; 50 million for export; and 50 million for inventory. The plastics distribution is roughly around 100 million for phenolic molding, 85 million or more for laminates, 165 million for bonding and adhesives of all sorts including plywood, and the balance for miscellaneous.

Further evidence of Gulf's growing role as a supplier to the plastics industry was its recent dedication of a new 35 million lb./yr. "Oxo" alcohol plant, where isooctyl, decyl, and tridecyl alcohols for use in plasticizers will be produced. Gulf first started production of isooctyl alcohol in 1953. Isooctyl, used in the manufacture of DIOP, has now been in competition with DOP, made with octyl alcohol, for the past decade. These two are by far the most widely used plasticizers in the vinyl chloride industry, since they are generally recognized as having the best all-around properties (including low cost) of any plasticizers on the market.

Gulf's petrochemicals department, comprising only a few men in 1951, today has 50 highly trained employees. It is estimated that from 15 to 20% of Gulf's 1960 domestic earnings increase over 1959 can be attributed to petrochemicals. Last year sales showed a 29% increase over 1959, with ethylene, benzene, heptene, propylene polymers, sulfur, and toluene all rising to new high levels. Gulf claims that it is the leading merchant producer of ethylene for sale to consuming plants which produce polyethylene, ethylene glycol for anti-freezes, styrene for synthetic rubber and plastics, ethyl chloride for anti-knock fluid, and other products.

The company also produces propylene trimer, tetramer, and pentamer for detergents; sulphur from gases; cyclohexane from its benzene plant at Port Arthur which is used in nylon and plasticizers; and various other petrochemical items. In 1952 Gulf's chemical activities were furthered by formation of Goodrich-Gulf Chemicals Inc. for the purpose of developing a synthetic-rubber manufacturing business. The company is now also in the process of bringing out a new low-pressure polyethylene.

With reference to the Goodrich-Gulf connection and the fact that Gulf is now a large supplier of ethylene to polyethylene producers, the question arises as to what would happen if the growing tendency for PE producers to produce their own ethylene should squeeze them out of the market? A company spokesman implied that if such a thing should happen, Gulf is prepared to take its ethylene program one step further, regardless of possible competition with Goodrich-Gulf, for it does not plan to lose its position in ethylene.

Gulf's other connections are an interest in Callery Chemical, producer of boron fuels: Warren Petroleum, with sulfur interests in Texas; and 60% of British American Oil Co. Ltd of Canada, producers of sulfur, benzene, cumene propylene, which in turn owns an interest in B-A Shawinigan. Gulf also has foreign interests.

The petrochemicals now represent a \$7-billion industry in the U.S. and 6 billion lb. of product, or about 40% of the volume of all chemicals produced in the U.S., yet they still take only 2% of the crude oil processed. A barrel of oil costing about \$4 can be converted, in some instances, into petrochemicals worth more than \$300, but the value increase normally is from \$4 to \$25 a barrel because of the costs of upgrading.

Tiny epoxy rods

Easy-to-machine epoxy rods, from $^9/_{16}$ down to $^3/_{16}$ in. diameter, have been announced by Polytronics Co., Dunellen, N. J.

The new small epoxy rods meet

*Reg. U.S. Pat. Off.

News about R&A Adhesives

SINCE 1913

FOR ALL METALS AND ALL PLASTICS

New, "safer", easy-to-spray adhesive bonds polystyrene foams

For brush . . . trowel . . . spreader . . . push box . . .

Bondmaster® G458 Series

Our rubber-resin-based BONDMASTER G458 Series offers several viscosities to permit efficient bonding of 'styrene foams with just about **any** standard application technique. Most formulations in this Series let you combine almost immediately. Others permit extensive time delay between applying the adhesive and assembling.

Either way, you can now overcome the key problems involved in bonding these foams to themselves or to metals, wood, cement board, or other materials, since all feature high strength; moisture-resistance; resistance to odor absorption and transmission (essential in refrigerator work); resistance to freezing temperatures; and long-time aging properties in the completed bond.

Write for detailed technical data and profusely illustrated magazine article reprints describing typical time- and labor-saving "case histories".

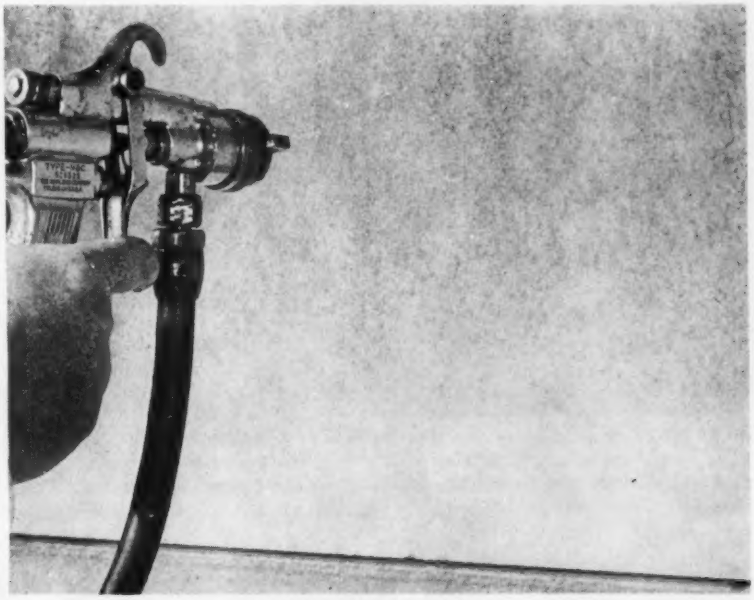
LOW-COST SOLVENT-FREE EPOXIES

If your application demands the high heat-resistance, structural strength or void-filling characteristics of a room-temperature-curing epoxy, write for information about BONDMASTER M685 and M686, specially formulated for bonding rigid expanded polystyrene foams . . . priced at ½ to ⅓ the cost of conventional formulations.

R&A SINCE 1913

RUBBER & ASBESTOS CORPORATION

243 BELLEVILLE AVENUE
BLOOMFIELD, NEW JERSEY



Low-cost mass-production-bonding of 'styrene foam "boards" to themselves or to other materials (such as to aluminum in siding manufacture, for example) usually calls for spray application.

Up to now, that technique has brought with it a host of problems: uniformity of spray pattern; entrapment of solvent; costly delays awaiting solvent evaporation; inadequate heat-resistance, etc.

SPRAYABLE BONDMASTER G415

To solve these problems and to speed production at lower cost, we've developed BONDMASTER G415 to give you peak efficiency in *spray* application. (Our G458 Series is still "tops" if you prefer to use a brush, spatula, push box, spreader, or trowel— see column at left.)

Not only do you achieve a more uniform spray pattern, but the solvent blend has been specifically formulated to provide you with "built-in" avoidance of cell attack (you can deposit a "semi-dry" film even if you spray directly to the foam!). The completed bond is not only sturdier but, in addition, features heat-resistance in the 160°-180°F range . . . substantially higher than that achieved with previous "non-attack" adhesives for this expanded foam.

WRITE FOR SAMPLES AND DATA

If you are using spray equipment to mass-production-bond 'styrene foams, write for technical data and samples of BONDMASTER G415. If you are working with brush, spreader, or trowel, it will pay you to investigate the BONDMASTER G458 Series. Either way, you will now find it possible to safely bond these critical foams without fear of cell attack . . . faster, better, more economically.

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the specifications and requirements of the resistor industry. They are non-melting, self-extinguishing, and distortion resistant under ultra-high-heat conditions, states the company.

Bachner Award winners named

An acetal housing for the instrument cluster of the 1961 Valiant has been named the winning entry for the Second Bachner Award Competition. Injection molded of Du Pont's Delrin, the dashboard component was one of the first major applications involving the use of acetal resin in the automotive industry.

The first-place trophy, together with a $1000 cash prize for designing personnel, was awarded to the Chrysler Corp. at a June 7 dinner at the St. Moritz Hotel, New York, N.Y. Three honorable mention citations were also announced at this time.

Held under the aegis of the Chicago Molded Products Corp., Chicago, Ill., which appoints a judging committee consisting of prominent members of the plastics industry, the Bachner Award Competition is held biennially to coincide with the National Plastics Exhibition and Conference of the Society of the Plastics Industry Inc. Initiated in 1957, the award is named for E. F. Bachner, co-founder of the sponsoring company.

Honorable mention plaques for 1961 were given to:

Franklin Mfg. Co., Minneapolis, Minn., for a one-piece vacuum formed high-impact polystyrene refrigerator liner, using 0.250-in. sheet.

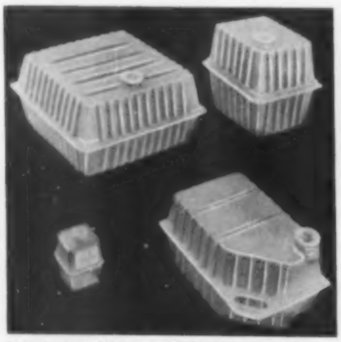
Albert Mojonnier Inc., Franklin Park, Ill., for vacuum formed linear polyethylene single-use containers for dairy products.

Landis Industrial Co. Inc., Santa Clara, Calif., for a railroad refrigerator car door liner, which is fabricated principally of ABS sheet components combined with expandable polystylene insulating filler.

Selection of the instrument housing as the winner for this year's competition was based largely on its significance in terms of plastics industry growth. The component, which weighs 2 lb., replaces a 9½-lb. zinc diecasting unit. Its success proves two important points: 1) that a thermoplastic material can hold its own as a structural member in the automotive industry, and 2) that a plastic resin can be integrated smoothly into mass production lines which use existing production facilities.

A. G. Loofbourrow, director of engineering for the automobile company, accepted the trophy. Other personnel from Chrysler's Engineering Div. sharing in the honors were:

FIRST PRIZE in the Bachner Award competition went to Chrysler Corp. for this acetal instrument cluster for 1961 Valiant. Component, which weighs 2 lb., is injection molded. Inset shows housing fitted with instruments and dials.



HONORABLE MENTION: Single-use milk containers are made by Albert Mojonnier Inc. of two approximately equal halves vacuum formed of PE or polypropylene sheet. Halves are heat sealed together at point of filling. Shipped in nested form, the containers save shipping and storage space, are light enough to compete with paper.

HONORABLE MENTION: One-piece refrigerator liner, vacuum formed by Franklin Mfg. Co., using 0.250-in. polystyrene sheet.

HONORABLE MENTION: Seen through doorway is the 8½ by 9¼ ft. refrigerator car door liner which Landis Industrial Co. makes by vacuum forming ABS copolymer sheets.

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Maurice F. Garwood, chief engineer of Materials Laboratories; Allan J. Carter, assistant chief engineer, Organic Materials Laboratories; Harold L. Lorenz, supervisor of the Plastics Laboratory; and Robert E. Bingman, chief stylist—Development, Styling Section, who was awarded the plaque for Industrial Designer of the Winning Entry. Chrysler Corp. has indicated that the money will be donated to a non-profit organization, selected by the Bachner Award Committee, for the further advancement of the plastics industry.

The trophy, suitably engraved, is made of acrylic. It was designed by Jean Reinecke, Chicago, Ill. industrial designer.

The first trophy was awarded in 1958 to Bissell Inc., Grand Rapids, Mich., for its Shampoo Master made with 14 plastic parts involving eight different plastics materials.

Judges for this year's competition were: Harley J. Earl, chairman of Harley Earl Assocs., Detroit, Mich., chairman; William P. Gobeille, mgr., Plastics Operations, American Motors, Detroit; Ivar P. Jepson, vice-pres., Research & Development, Sunbeam Corp., Chicago; Dr. Ralph G. Owens, Illinois Institute of Technology, Chicago; and Hiram McCann, Editor-in-Chief, MODERN PLASTICS magazine, New York.

The Bachner Award Committee, a separate unit from the judging panel, consists of: Mr. Earl as chairman; Lee T. Bordner, pres., Sierra Electric Co.; Arthur J. Schmitt, chairman of the board, Amphenol-Borg Electronics Corp.; and Charles A. Breskin, chairman of the board, Breskin Publications Inc. William T. Cruse, exec. vice pres., The Society of the Plastics Industry Inc., serves as the committee's secretary.

New process for urethane foam

Latest technique to join the ever-widening circle of methods for processing urethane foam involves the casting of the foam directly onto a backing. As developed by Specialty Converters Inc., East Braintree, Mass., the prepolymer, in liquid form, is fed through a mixing head onto the backing as it passes beneath it on a continuous belt. As the prepolymer hits, it foams slightly. The coated backing then passes through calendering rolls which are set to control the amount of prepolymer (and hence, the finished foam) that is laid on. The material then passes through an oven where it foams up. At the present time, the company is concentrating on specialty applications where the foam will be applied to such substrates as polyethylene film (for packaging), vinyl film (for shoes, handbags, etc.), or aluminum foil (for air conditioner ducting). The company is currently producing the material on a pilot plant basis but full commercial production is expected soon. The company plans to set up licensing arrangements on the know-how involved.

Of much interest, too, is a new technique which the company has developed for incorporating reinforcing material, *e.g.*, scrim, fibers, webbing, etc., directly into the urethane foam while it is being cast. The reinforcement increases the tensile strength of the foam in both directions. The reinforced foam is already in use (with a glass scrim reinforcement) as a conveyor belt for use in a color film processing operation.

Water-soluble copolymers

A series of vinyl ether-based polymers and copolymers, trademarked Gantrez, has been announced by the Commercial Development Dept., The Chemical Group, General Aniline & Film Corp. Gantrez AN, the first of this series, is now available in semi-commercial quantities in low, medium, and high viscosity at a development price of $1.25/lb. in truck and carload lots, packaged in drums.

Gantrez AN resin, a water-soluble copolymer of methyl vinyl ether and maleic anhydride (PVM/MA) is available as a free-flowing, white powder. This film-forming copolymer

Comparison of plastics material costs with metal

Material	*Sp. Gr.*	*lb./cu. in.*	*Cost* ¢*/lb.*	*Cost* ¢*/cu. in.*
Polyethylene	0.914 to 0.96	0.0330 to 0.0346	26.0 to 39	0.86 to 1.32
Acetal	1.425	0.0514	65	3.34
Methacrylate	1.19	0.0426	55	2.34
Nylon	1.14	0.0412	98	4.04
Polystyrene, g.p.	1.06	0.0383	18.0	0.69
Polystyrene, high impact	1.05	0.0379	27.5	1.04
Polypropylene	0.90	0.0325	42	1.36
Impact acrylic resin	1.12	0.0404	46.5	1.88
ABS resins	1.02 to 1.08	0.0368 to 0.0386	47 to 60	1.80 to 2.34
Polyvinyl chloride, rigid	1.33 to 1.39	0.048 to 0.050	26 to 40	1.25 to 2.00
Cellulose acetate	1.27	0.0458	44	2.02
Cellulose acetate butyrate	1.19	0.0430	62	2.67
Celluose propionate	1.21	0.0436	62	2.71
Ethyl cellulose	1.10	0.0397	72	2.86
Polycarbonate resin	1.20	0.0433	130	5.63
Chlorinated polyether	1.4	0.0505	250	12.62
Magnesium AZ-91B	1.81	0.0653	30.78	2.01
Aluminum SAE-306	2.77	0.100	22	2.20
Aluminum SAE-309	2.64	0.0953	23.75	2.26
Zinc SAE-903	6.6	0.238	14.25	3.39
Brass—Yellow (#403)	8.5	0.307	28	8.60
Brass—85/5/5/5	8.75	0.316	32	10.11
Steel—CR Alloy (strip & bar)	7.85	0.283	9 to 15	2.55 to 4.24
Steel—Tool—Standard 0.95C	7.82	0.282	33	9.31
Steel—Stainless 304	7.92	0.286	46.75	13.37

The material costs shown above are believed representative of the pricing on May 18, 1961. However, no guarantee as to accuracy can be given. For a detailed comparison, the latest prices should be obtained from the suppliers of the various materials.

Winter-summer flexibility and durability for vinyls

MONOPLEX® S-73, an epoxy-ester plasticizer for vinyls, provides a combination of flexibility at freezing temperatures and durability in summer sunlight. And even though MONOPLEX S-73 shows permanence properties superior to most other low-temperature plasticizers, its cost in the vinyl compound is usually lower.

The unusual permanence properties of MONOPLEX S-73 stem from: (1) its stabilizing effects against heat and ultraviolet light degradation, (2) low volatility, (3) good compatibility with PVC, even under rigorous exposure conditions, (4) better resistance to migration than normally shown by low-temperature plasticizers. Excellent color and clarity of MONOPLEX S-73 make it an ideal choice for transparent rainwear, rear windows for convertibles, and auto seatcovers. Its viscosity properties are excellent for plastisol uses. Economy comes from moderate price and low specific gravity. Write for two free booklets: *Performance Properties of* PARAPLEX® *and* MONOPLEX *Plasticizers*, and *Properties of Plastisols*.

ROHM & HAAS

PHILADELPHIA 5, PA.

MONOPLEX S-73

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is used in chemical processing, textile, leather, paper, photo-reproduction, adhesives, coatings, as well as cosmetics industries.

Gantrez AN functions as a water-soluble protective colloid in aqueous systems and has proved useful in both emulsion and suspension polymerization. Its compatibility with other water-soluble gums and resins used in polymerization recipes enhances its utility in these systems. It is of particular interest in the suspension polymerization of vinyl chloride and its vinyl acetate copolymers as a particle size regulator for the 40- to 200-mesh range and as a dispersant and viscosity control agent.

Spencer's foreign operations

The plastics industry will be interested to know that Spencer Chemical Co.'s sales agreements with export agencies have expired and that Spencer Chemical International has taken charge of all overseas operations, including exports and foreign investments. SCI will also market products supplied from other sources.

President of the subsidiary is Albertus Slingerland, a native of Holland, once with Hercules, who joined the company in 1958. He has established coordinating offices in Luxembourg, which is also headquarters for Spencer Chemical-Luxembourg that handles European marketing. R. L. McAllister will be plastics products manager there. Other offices will be in Lima, Peru, and Tokyo, Japan. Carl Flesher, former officer for International Cooperation Administration, has joined Spencer in Kansas City to seek investments overseas.

Carbide introduces low-cost vinyl plasticizer

A new primary plasticizer that provides good compatibility with vinyl chloride resins and copolymers is now available from Union Carbide Chemicals Co. Designated Flexol 13-13 (ditridecyl phthalate), the plasticizer is recommended by UCC for vinyl automotive upholstery and gasketing that offers low fogging characteristics and soapy water resistance.

For use in high-temperature vinyl wire compounds, this plasticizer is inhibited with 0.25% by weight bisphenol A and designated Flexol Plasticizer 13-13X. It has good resistance to chemical breakdown at high temperatures and has low volatility, making it useful as a primary plasticizer for vinyl compounds that meet UL specifications for 75THW build-

ing wire and 80 and 90° C. wiring. Compounds made with 13-13X retain good insulating properties after water immersion, and retain good tensile strength and elongation properties after oil immersion.

The prices per lb. for both plasticizers, in the Eastern territory, are: 28¢ in tank car lots, 30¢ in carload or truckload lots of drums, 31¢ for one to nine drums, and 30.5¢ for 10 or more drums. All prices are 1.5¢ higher per lb. in the Western part of the U. S.

Non-burning epoxy resin

A new flame-retardant low-viscosity epoxy resin, from Ciba Products Corp., has shown preliminary promise in adhesives, tooling, flooring, laminating, and electrical insulation fields. The new resin, Araldite DP-440, is based on a new series of halogen containing cycloolefinics. It can be cured at room or slightly elevated temperatures with amine hardeners.

Merchandising technique for laminators

The Micarta Fabricators Assn., claimed to be the first trade organization of industrial plastics fabricators, held its second annual meeting on April 18 to 20 at Hilton Head Island, S. C., near the plant of the sponsoring Westinghouse Electric Corp.'s Micarta Div. at Hampton, S. C.

The seminar-type meeting featured discussions of fabrication methods, product engineering, marketing, and research in the utilization of industrial plastics.

The MFA has now expanded to include 25 of the major industrial plastics fabricators throughout the country. In addition to furnishing technical data, Westinghouse also identifies members of the association in national advertising, publicity, and promotion. Member firms use the association's insignia to symbolize high product quality and to identify the firm as a user of research and engineering counsel.

According to D. L. Sweeney, sales manager for industrial Micarta products: "This association, which began as an experiment, has more than proved its value in exchange of information and cooperation beneficial both to the individual industrial plastics fabricators and to Westinghouse Electric Corp."

Member firms include: F. H. Maloney Co., Houston, Texas; White Supply Co., St. Louis, Mo.; Laminated Sheet Products Corp., Norwood, Mass.; Insulating Fabricators Co., Inc., E. Rutherford, N. J.; Insulating Fabricators of New England Inc., Watertown, Mass.; Almac Plastics Inc., New York, N. Y.; Brownell Inc., N. Y. C.; Herschel Engineering & Supply Co., Philadelphia, Pa.; Ray

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V. Watson Co., Baltimore, Md.; Wood Plastics Inc., Wayne, Pa.; Jaco Products Co., Cleveland, Ohio; Wm. F. McGraw & Co., Detroit, Mich.; Earl B. Beach Co., Pittsburgh, Pa.; Engineered Plastics Inc., Gibsonville, N. C.; Insulating Fabricators, Spartanburg, S. C.; Cortland Industries Inc., Chicago, Ill.; Mandex Mfg. Co., Chicago; Fiber Fabricators Co. Inc., Chicago; Thombert Inc., Newton, Iowa; IMMANCO Fabricating Div. of Insulation Mfrs. Corp., Chicago; Vanderveer Industrial Plastics Co., Angus Campbell Inc., Leed Insulator Corp., Conroy-Knowlton Co., all of Los Angeles, Calif.; and Pam-Pro Plastics, Menlo Park, Calif.

Offers epoxy foam resins

For several years, Shell Chemical Co. has been on the verge of introducing an epoxy foam; now they've finally done it. Two formulations have been developed and are available in product development quantities, with prices in the range of standard polyester-type urethanes.

Epon-Foam Resin H-10.1, when mixed with Epon Curing Agent G-7, forms a low-density rigid foam (2.9 lb./cu. ft., average). Using foam-in-place techniques, foam is produced at room temperature in unheated molds, and is ready to handle about 15 min. after catalyst addition. A fluorinated hydrocarbon blowing agent is used. Foam can also be sprayed-up easily. Both resin and curing agent are said to have a shelf life of at least one year in tightly closed containers. Thermal conductivity [B.t.u./hr./ft.^{2} (°F./in.)] is 0.113 to 0.129, and compressive strength is 20 to 26 p.s.i. Since these foams are based on epoxy resins, adhesion to a wide range of materials is excellent.

Epon-Foam Resin H-60, mixed with Epon Curing Agent G-8, forms a self-extinguishing foam which, except for this feature, has essentially the same properties as H-10.1: Density—2.9 lb./cu. ft.; thermal conductivity—0.112 to 0.123 B.t.u./hr./ft.^{2} (°F./in.); compressive strength—22.2 to 24.6 p.s.i.

Concrete joint sealers

Plastic waterstops, which are used for sealing joints permanently in concrete, have been added to its line of industrial plastics by Joseph T. Ryerson & Son, Chicago, Ill. The new product is available through the firm's service centers located in 20 cities over the country.

The waterstop, marketed under the tradename of Ryertex-Omicron PVC, is of ribbed design for high holding power in concrete, and has a hollow center bulb for extra flexibility and

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elasticity. It is supplied in 50-ft. coils of 3/16-in. thickness, in 4-, 6-, and 8-in. widths. It will not corrode, provides maximum durability and water-tightness, will not harden or crack with age, and is not subject to electrolytic action. It is completely unaffected by chlorine, sewage, or sea water, and is said to also withstand the action of more than 200 other corrosive solutions.

Installation is simple and easy; the waterstop may be cut with a hand saw or sharp knife, and can be spliced or butt-welded with the application of heat.

Fire-retardant skylights

Fibrous glass reinforced skylights, made with Hetron polyester resin by Consolidated General Products Inc., Houston, Texas, are claimed to be self-extinguishing once the source of flame is removed. The plastic dome-type units, tradenamed Consolite, are said to be shatterproof and crack-proof, with good light transmission and diffusion, durability, and weathering qualities. Pasteltone Consolites are available in a variety of sizes and shapes for industrial, residential, commercial, and institutional construction.

For added durability, units can be coated with Hetrolac 105, an acrylic lacquer incorporating an ultra-violet absorber. Both Hetron and Hetrolac are products of the Durez Plastics Div., Hooker Chemical Corp., N. Tonawanda, N. Y.

Company reports

Vulcan Corp. directors chose Joseph B. Reynolds, who has served as president since 1955, to be board chairman; and elected Lawrence B. Austing, executive vice-president and a director since 1957, to be president.

For 1960, Vulcan reported earnings and sales recorded a 20% increase over the previous year. Vulcan profits in 1960 after taxes amounted to $557,835. The company is in its 51st year of operation.

Until two years ago, Vulcan produced shoe lasts, shoe heels, bowling pins, bungs, furniture components, and the like from wood. Since then, the company has entered the field of injection molded plastics, manufacturing shoe heels from plastic.

A decade ago, Vulcan, at its Antigo, Wis. plant, entered production of bowling pins from hard maple. Two years ago, Vulcan developed and introduced the Nyl-Tuf nylon plastic sleeve bowling pin with hard maple core. Vulcan now (To page 197)

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ranks among the four largest manufacturers of bowling pins in the U.S.

Sta-On, a polyurethane toplift whose dowel construction grips the lift in an interlocking bond, is manufactured by Whitso Inc., and distributed solely through Vulcan Corp. It is manufactured from a specially formulated material developed jointly by a leading chemical company and Whitso engineers. As such, the formulation is reserved exclusively for Whitso's use, and replaces the polyurethane formulation originally used.

The accelerated wear test of Sta-On toplifts on a "perpetual walking machine," reported by Vulcan, not only showed the toplift to be at least 25% better than its nearest competitor, but also indicated that it would require more than 400 hr. of actual walking before the lift would be worn down enough to even show metal.

The Fluorocarbon Co. Sales in excess of $1 million for 1960 were announced by George Angle, board chairman of The Fluorocarbon Co., Anaheim, Calif., processors and fabricators of Teflon and Kel-F. Mr. Angle indicated this represents an 11% increase over the previous year. Profits rose to 8.1 percent. He also cited a 20% increase in personnel during the year.

Mr. Angle pointed to the establishment of a national network of distributors and manufacturer's agents as major reason for Fluorocarbon's upward sales curve and revealed that plans for 1961 call for the further strengthening of the company's distributor organization.

He indicated that, during 1961, the company plans to introduce several new fluorocarbon products. Major item during the past year was the introduction of a new Teflon sheet said to possess greater tensile strength, elongation, and stability than any previously marketed.

Kleer-Vu Industries. Net earnings in 1960 for Kleer-Vu Industries Inc., New York, N. Y., were $101,128, an increase of 178% over the previous year, according to the company. Consolidated net sales rose 17% to $2,539,027 in 1960, from $2,163,553 that was recorded for the previous 12-month period.

Kleer-Vu is engaged primarily in the manufacture of acetate and polyester transparent products, such as jackets for the storage of microfilm strips, transparent billfold accessories and wire bound inserts, envelopes and

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sheet protectors, photo albums and index units, as well as ultrasonic sealing equipment.

Company subsidiaries include American Kleer-Vu Plastics Inc., New York, N. Y.; Kay Vee Products Inc., Puerto Rico; Kleer-Vu Plastics Inc., Brownsville, Tenn.; Kleer-Vu Plastics Co. Ltd., Toronto, Canada; Microfilm Jackets Inc., Brownsville, Tenn. and N. Y. C.; and Ultra Sonic Seal Inc., Ardmore, Pa.

Reporting on progress at the various locations, president Benjamin B. Osher stated that American Kleer-Vu Plastics Inc. has introduced Vular, a new polyester film developed by Eastman Chemical Products Inc.

Kleer-Vu will increase the size of its present quarters by 60% to permit the addition of new production and warehouse facilities. Mr. Osher said an upturn in activity had been experienced by Kay Vee Products in the manufacturing of transparent wallet accessories.

Polymer Corp. Sales of $1,926,000 and net profit of $130,000 for the quarter ended March 31, 1961, were reported by The Polymer Corp., Reading, Pa. For the first quarter a year ago, sales totaled $2,031,400, with net profit amounting to $143,900.

Although business improved in March, Louis L. Stott, president, said the increase failed to offset the below-budget volume recorded in January and February.

Sales estimates for the current and following quarters indicate that, for the balance of the year, Polymer's sales should exceed those of 1960 for the comparable periods, he declared. The prospects are good that 1961 will see the development of substantial new uses for Polymer's Whirlclad Coating System, Mr. Stott announced. Among the companies reportedly using the patented system are General Electric, Westinghouse, and Allis Chalmers.

Polymer's Whirlclad System is a West German development for which Polymer holds exclusive license in the United States and Canada. It is a process based on a fluidized bed technique whereby dry thermoplastic coating powder is fused to material such as metals and glass. The powders are specially developed by Polymer from such materials as nylons, vinyls, epoxies, polyethylenes, and polyethers.

Northwest Plastics Inc. Sales of Northwest Plastics Inc. **(To page 202)**

ANNOUNCING

The New NIKKO Equipment That Produces Non-Plasticized Polyvinyl Chloride Film!

Over half a century's experience and technical knowledge that has made JAPAN STEEL WORKS, LTD. the foremost among Japan's steel products and machinery manufacturers, now makes the world's most advanced equipment that processes non-plasticized polyvinyl chloride film — the dependable NIKKO Extruder & T-Die System Film Unit. The traditionally strict standards of NIKKO efficiency and durability bring you this latest development in plastics machinery.

Look to High-Capacity NIKKO EXTRUDERS for:

pipe, tube, T-die system film, embossing film, inflation system film, sheet, corrugated sheet, blow moulding, monofilament, wire and cable coating, laminating, pellets, straining, profile, etc.

NIKKO EXTRUDERS
Standard Specifications

Model No.	Drive motor kw	Screw			Heater		Output kg/hr
		Diameter mm	L/D	rpm	Zone	kw	
P 25—12	2.2	25	12	40~120	2	2	4
P 40—22	5.5	40	22	40~120	3	4	25
P 65—22	11	65	22	40~120	3	12	60
P 90—22	30	90	22	40~120	3	22	110
P 112—20	37	112	20	27~80	4	32	200
P 150—20	55	150	20	22~65	4	54	400
P 200—20	150	200	20	17~50	5	100	600
P 250—20	190	250	20	15~45	5	140	800
P 300—20	220	300	20	12~35	5	180	1,000

Note: Model No. includes figures corresponding to the screw diameter and L/D

P90-22 Type Extruder & T.Die System Film Unit

For detailed information, write

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CABLE ADDRESS: SEIKOSHO TOKYO

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dropped from $3,112,000 in 1959 to $3,017,000 in 1960, but earnings were $67,290 in 1960, compared with $65,273 in 1959. Northwest is one of the few companies that isn't complaining about a drop in earnings compared with sales volume.

J. R. Freyermuth, pres. of the St. Paul, Minn. firm, says the drop in sales was caused by generally poor business in the appliance and communications industries. The company is now moving more heavily into the fields of electronics and recreational products.

Highlights for Northwest in 1960 were construction of a new plant in Grundy Center, Iowa, and doubling capacity of the Belle Plaine, Minn. plant. Other plants are in St. Paul, Minn. and Gastonia, N. C.

Mr. Freyermuth is just about the most enthusiastic booster for plastics in existence. Among his prognostications: houses built in the next 10 to 20 years will contain more plastics than any other product; that automobiles now contain 70 lb. of plastics compared with 6 lb. in 1941; that refrigerators which had 3 lb. in 1941 now contain 52 lb. and that they will soon contain 100 pounds.

Tri-Point Industries Inc. Sales and earnings for Tri-Point Industries Inc., Albertson, N. Y., during the company's fiscal year, which closed on Feb. 28, were $1,931,105—a gain of 19% over the previous year and earnings increased 27.9 percent. This increase in net earnings occurred after deducting the expense of establishment of the company's new plant, which is engaged in Teflon processing and manufacturing.

In making this announcement, President Sal Mulay also referred to the cost of setting up and activating its southern subsidiary, Tri-Point of Florida Inc., St. Petersburg, Fla. He added that Tri-Point of Florida is a sales, service, and distribution center for Teflon products produced by the parent company. This subsidiary is also the distributor for Connecticut Hard Rubber Co., Dilectrix Corp., and Industrial Coatings Co. in the southeastern states, and the distributor of Teflon products made by Electric Autolite Co. and Raybestos-Manhattan Inc.

Expansion

Mobay Chemical Co., Pittsburgh, Pa., has completed plant facilities that will raise production capacity for toluene

diisocyanate (TDI) from 25 to 40 million lb., with an additional 10-million-lb. increment planned for this fall. The projected increase will be Mobay's fifth major expansion since its original 10-million-lb. TDI plant went on stream in 1956 at New Martinsville, W. Va. TDI is used in the manufacture of urethane foams, elastomer products, and industrial coatings.

Union Carbide Corp. will participate with **Superfosfat Fabriks Aktiebolag (Fosfatbolaget)** of Stockholm in a joint venture to construct a 35 million lb./yr. polyethylene plant in Sweden. Located near Gothenburg, this plant will be completed in 1962, and will represent the first polyethylene manufacturing plant in Sweden.

Michigan Chrome & Chemical Co., Detroit, has acquired **Allied Research & Engineering Co.,** Hollywood, Calif., which will operate as a wholly owned subsidiary in the technology of electroforming. **Paul Harper,** formerly West Coast district manager for the Chemical Division of the parent company, has been promoted to general manager of Allied Research & Engineering.

A. G. Bardes Co. Inc. has opened a new plant at 5225 W. Clinton Ave., Milwaukee, Wis., to manufacture transparent plastic containers, lids, envelopes, and vacuum-formed packages. A major material used in the company's line of packages and protective products will be Vuepak cellulose acetate produced by **Monsanto Chemical Co.'s** Plastics Division.

General Foam Corp. has expanded facilities in Hazleton, Pa. for the manufacture and processing of urethane foam, by leasing a 68,000-sq.-ft. building directly across the street from its existing plants. A tunnel conveyor will be constructed under the roadway to connect the buildings. Integrated operations using the conveyor are scheduled soon.

Packaging Corp. of America, Chicago, Ill., continuing its expansion into expanded polystyrene packaging, has opened its third plastics plant in Vincennes, Ind. The company's initial move into plastics was the acquisition of **Worcester Molded Plastics Co.,** Worcester, Mass., and the purchase of the plastics division of **Lakeside Mfg. Co.,** Milwaukee, Wis.

The Glidden Co., Cleveland, Ohio, has entered into the production of fabricated building products with the purchase of **McPhran Corp.,** Marietta, Ga., makers of fibrous glass panels for residential and industrial

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uses. In announcing the purchase, **Paul W. Neidhardt,** Glidden vice-president, said "This expansion was undertaken because these fibrous glass products are suited for distribution through our established channels, thus minimizing distribution costs, and because they give us another important outlet for our polyester resins."

Weber Plastics Inc., Stevens Point, Wis. custom molder of expandable polystyrene, has completed a new 5000-sq.-ft. warehouse. Last year, Weber Plastics Inc., a wholly owned subsidiary of **Weber Tackle Co.,** completed a two-story addition to the original Weber factory to house new automated plastic molding equipment.

Extrudo-Film Corp., New York, N. Y., has announced its expansion into the manufacture of construction and agricultural polyethylene films. **H. E. "Ed" Nasse,** formerly with Union Carbide Corp., Visking Div., has been named manager of sales to this field. Extrudo-Film is also a producer of heavy-gage polypropylene sheet.

The company's Pottsville, Pa. plant was opened in 1959 and is at present being substantially expanded. In 1960 the acquisition of the Alfred Charles Co. and N & N Extruders was followed by the company's entry into cast polyethylene and polypropylene films as well as the beginning of shipments of products from its Wentzville, Mo. plant.

Norman Forrest Research Corp. has expanded its research and development facilities at a new plant at Byram Rd., Byram, Conn. The company specializes in design and development consulting on decorative vinyls, with special emphasis on embossing roll manufacture.

Nopco Chemical Co., N. Arlington, N. J., manufacturers of urethane foam, has acquired six Midwest foam companies from the **D & W Clark Corp.,** a privately owned Chicago, Ill. firm, for 30,000 shares of Nopco common stock. The six companies are all engaged in the fabrication and distribution of urethane foam, as well as foam rubber, upholstery fabrics, vinyl sheeting, and fiber products used primarily in the furniture, bedding, and cushioning industries. The combined sales of the six Clark companies for the 12 months ending March 31, 1961 were in excess of

$5.8 million. Nopco sales for the year ended Dec. 31, 1960 were $39.8 million. Nopco has just recently expanded its facilities at N. Arlington, and on May 15, a new foaming and fabricating plant went on stream at Chattanooga, Tenn. Design and engineering of an additional foaming plant in the Midwest have already been completed, and it is contemplated that such a plant will be in full operation before the end of 1961. Nopco in 1961 will also complete construction of a multimillion dollar facility at Linden, N. J., to produce toluene diisocyanate (TDI).

Wyandotte Chemicals Corp's Michigan Alkali Div. has announced plans for construction of a new $3.5 million propylene oxide plant on 23 acres of waterfront property at Wyandotte, Mich., recently acquired by the company. Propylene oxide is an important raw material used in the manufacture of chemicals for flexible and rigid urethane foams.

National Starch & Chemical Corp. has acquired **Kleen-Stik Products Inc.,** producer of pressure sensitive labelling papers, foils, and films. Kleen-Stik will operate as a subsidiary corporation, and the present management will continue to direct all operations of the new company.

National Starch & Chemical Corp. is a manufacturer of packaging adhesives, and a producer of vinyl acetate polymers and copolymers.

Reichhold Chemicals Inc. and **Adolfo Vilanoya Jr.,** Puerto Rican manufacturer, have formed **Reichhold Chemicals Del Caribe Inc.** for the production of synthetic resins and latex emulsions. The new company will be operated through license agreement and supervision of Reichhold Chemicals Inc., White Plains, N. Y.

Initial capitalization of the company's new plant is approximately $500,000. The output of the plant will be sold through **C. Withington Co. Inc.,** Long Island City, N. Y., and **Santurce,** Puerto Rico.

Thermoplastic Processes Inc., Stirling, N. J., has increased production of custom extrusions with the addition of 6000 sq. ft. of new plant facilities, and is supplementing its existing line of vinyl tubing (Excelon) with a stock line of acrylic and butyrate tubings.

New companies

Materials Research, Warsaw, Ind., has been formed by **Rex Bradt,** president, as an independent research and pilot plant working exclusively in plas-

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tics. Facilities at the 15,000-sq.-ft. pilot plant at nearby Claypool, Ind., include equipment for polymerization compounding, test molding, coating, dipping, and weathering use tests. A small testing facility has been set up by the firm in Florida, for testing fibrous glass products, plastics, and coatings under semi-tropical conditions. Mr. Bradt is founder and also president of **Fiberfil Corp.,** also of Warsaw, which makes a variety of fibrous glass reinforced injection molding compounds.

Petal Enterprises Inc., 107 Trumbull St., Elizabeth, N. J., has been formed for the primary purpose of fabricating custom industrial protective coverings and industrial aprons, using mostly laminated materials. Among the new applications are chemical tank liners, tarpaulins, shipping containers, air houses, jet engine covers, marine deck covers, awnings, and similar products.

Coming events

Plastics groups

Sept. 12: S.P.E. Central Indiana Section, Retec, "Plastics for Tooling," Hotel Severin, Indianapolis, Ind.

Sept. 22-Oct. 1: International Plastics Fair, Copenhagen, Denmark. Contact: Int. Plastics Fair Secretariat, 10 Puggaardsgade, Copenhagen.

Oct. 12, 13: S.P.I. 17th Annual New England Section Conference, Wentworth by-the-Sea, Portsmouth, N. H.

Oct. 17-19: The Plastics Show of Canada, Canadian National Exposition, Toronto. Contact: W. B. Pryde, Show Manager, 481 University Ave., Toronto, Canada.

Other groups

Aug. 6-12: 18th International Congress of Pure and Applied Chemistry, Montreal, Canada. Chrmn.: P. A. Novikoff, Canadian Industries Ltd., 130 Bloor St. W., Toronto, Canada.

Aug. 28-Sept. 1: Gordon Research Conferences on Adhesion, New Hampton School, New Hampton, N. H.

Sept. 5-8: American Chemical Society, Chicago Section, 11th National Chemical Exposition, International Amphitheatre, Chicago, Ill.

Oct. 18-20: Packaging Institute 23rd Annual National Packaging Forum, to be held at Biltmore Hotel, New York, N. Y.—**End**

COMPANIES . . . PEOPLE

Firms and personnel in the news—what they're doing . . . and where

Allied Chemical Corp.—Barrett Div. marketing reorganization: **John W. Faison,** formerly New York dist. sales mgr., named market mgr. for industrial, commercial, and institutional construction. **John W. Bruce Jr.,** previously marketing mgr. for protective coatings, appointed market mgr. for residential construction. **Harold J. Baker,** formerly asst. marketing mgr. for roofing, now market mgr. for renovation and modernization. **John W. Gore** named New York dist. sales mgr. succeeding Mr. Faison. **Theodore W. Breach** named asst. dist. sales mgr., and **Rudolph B. Novesky** appointed asst. to dist. mgr.

Naugatuck Chemical Div., U. S. Rubber Co., has transferred its vinyl plastic compounding operation from its main plant in Naugatuck, Conn., to newly erected facilities at its vinyl resin plant in Painesville, Ohio.

Dr. Harry D. Glenn named factory mgr. of the Div.'s two Baton Rouge, La. plants; producing Kralastic ABS molding materials, and synthetic rubber latices, respectively.

The Dow Chemical Co.: W. R. Dixon promoted from gen. sales mgr. to dir. of sales. He has been with Dow since 1936. **G. J. Williams,** formerly asst. gen. sales mgr., promoted to gen. sales mgr. **Oliver B. Beutel** named dir. of distribution and traffic.

L. E. Fake, films and sheeting product mgr., Plastics Sales Dept., transferred to **Dow Chemical International Ltd. S.A.,** Zurich, Switzerland, as product mgr. packaging materials, European operations.

The Dobeckmun Co.: William C. Mertz, sr. research chemist, promoted to dir. polyolefin film development.

Texas Butadiene & Chemical Corp., New York, N. Y.: **B. D. Berkman** joined the Polychemicals Dept. as sales development engineer. **John R. Hodson** appointed to newly created position of mgr. of sales services.

Air Reduction Chemical & Carbide Co. opened its new $300,000 chemical manufacturing and distribution facilities at City of Industry, Los Angeles County, Calif. The new plant is devoted to resin polymerization and produces Flexbond and Vinac resins. Used in the formulation of paints, adhesives, and paper coatings, Flexbond copolymer emulsions and Vinac polyvinyl acetate emulsions, beads, and powders are marketed by the company's **Colton Polymers Dept.**

Cabot Corp., Boston, Mass. producer of chemicals and carbon black: **D. Brittain Briggs Jr.** joined the process design and economic section, New Products Research Dept., as chemical engineer. **Leslie H. Spiro** joined the International Div. as European tech. service rep. in special blacks. **James J. Brennan Jr.** joined the Carbon Black Research Dept.

Johns-Manville Sales Corp., fibrous glass section: **Charles F. Briggs** appointed sales rep., Atlanta, Ga. territory. **Robert D. Wisbon** assigned to Philadelphia, Pa. area. **Thomas D. Hoffstatter** named sales rep., Tulsa, Okla. territory.

Wyandotte Chemicals Corp., Wyandotte, Mich., opened its first Eastern plant in Washington, N. J. The new twin-reactor plant manufactures polyether products for expanding markets in the East. A third reactor currently under construction is scheduled for completion in mid-August.

Owens-Corning Fiberglas Corp., New York, N. Y.: **William J. Clark,** formerly v-p and advertising dir., appointed v-p, Reinforced Plastics Marketing Div. **Frederick L. Purtill** named v-p, marketing, Pacific Coast Div., with headquarters in Santa Clara, Calif. **Guy O. Mabry** appointed v-p, Southeastern region, with headquarters in Atlanta, Ga. **William W. Boeschenstein** named head of the corporation's sales branch operations, with headquarters in Toledo, Ohio.

Escambia Chemical Corp., Wilton, Conn.: **John T. Barr Jr., James F. Gabbett, Louis Mikkelsen,** and **Erwin F. Schoenbrunn** promoted to position of Group Leader at the Wilton Research Center.

Continental-Diamond Fibre Corp., Newark, Del.: **Robert S. Handly** elected v-p mfg. **Jack P. Yoder** appointed research specialist, laminate research section, R & D laboratory.

Lermer Plastics Inc., Garwood, N. J., established a new flexible plastic container div. for mfr. of acetate containers in diameters of ¼- through 1¼-in., in lengths as needed.

Kaykor Products Corp., Yardville, N. J., has purchased **Kaykor Industries Div.** of **Kaye-Tex Mfg. Corp.,** and is now operating it as an independent company. Kaykor Products Corp. produces a variety of vinyl, styrene, and other thermoplastic sheet laminates. **J. L. Huscher** is pres.

The Society of the Plastics Industry Inc. (S.P.I.): Following officers and directors were elected for the fiscal term beginning June 1961: **Walter F. Oelman, Standard Molding Corp.,** Dayton, Ohio, elected pres., replacing **Russell C. Weigel** of **Du Pont,** who moved to chrmn. of the board. **T. T. Miller, W. R. Grace & Co.,** elected v-p, and **Harry M. Jenkins, General American Transportation Corp.,** Chicago, Ill., named secy.-treas.

Sectional directors: *Canadian Section,* **Adolph Monsaroff, Monsanto Canada Ltd.;** *New England Section,* **John W. LaBelle, Foster Grant Co. Inc.;** *Western Section,* **J. Allen Carmien, Nupla Mfg. Co., Div. New Plastic Corp.**

Industry Div. and Comm. directors: *Cellular Plastics Div.,* **Samuel Steingiser, Mobay Chemical Co.;** *Code Advisory Comm.,* **Frank X. Ambrose, Alsynite Div. Reichhold Chemicals Inc.;** *Custom Molders Div.,* **Donald F. Dew, Diemolding Corp.;** *Fluorocarbons Div.,* **Victor G. Reiling, Modern Industrial Plastics Inc.;** *Food Materials Packaging Comm.,* **W. J. Sauber, The Dow Chemical Co.;** *Housewares Div.,* **A. C. Manovill, Ideal Plastics, Div. Ideal Toy Corp.;** *Machinery Div.,* **William H. Bennett, The Hydraulic Press Mfg. Co.;** *Mold Makers Div.,* **W. H. Monteith, Akromold Inc.;** *Profile Extruders Div.,* **Milton J. Lax, Kreidel Plastics Inc.;** *Public Relations Comm.,* **Robert W. Boggs, Union Carbide Plastics Co.;** *Reinforced Div.,* **Samuel A. Moore, Interchemical Corp.;** *Thermoplastics Pipe Div.,* **George H. Reed, American Hard Rubber Co., Div. Amerace Corp.;** *Vinyl Film Div.,* **Bernard Mittman, Elm Coated Fabrics Co. Inc.**

Directors at Large: Thomas F. Anderson, New Products Div., Haveg Industries Inc.; Philip J. Arnoff, Transparent Specialties Corp.; Morton Davis, Joseph Davis Plastics Co.; Henry DeVore, Plastics Div., Allied Chemical Corp.; Harold Dinges, Plastics Div., Spencer Chemical Co.; F. Norman Hartmann, Lily-Tulip Cup Corp.; William Marsh, U. S. Industrial Chemicals Co., Div. National Distillers & Chemical Corp.; Robert Morehouse, Kent Plastics Corp.; John H. Woodruff, Auburn Plastics Inc.

Miller-Stephenson Chemical Co. Inc., S. Norwalk, Conn., has established a Midwestern sales and warehouse headquarters at 445 N. Lake Shore Dr., Chicago, Ill. Lines handled include polyester resins, gel coats, fibrous glass products, adhesives, etc.

Roger W. Johnson joined the Research Div. of **G. T. Schjeldahl Co.,** Northfield, Minn. mfr. of packaging machinery, industrial tapes and adhesives, air-supported plastic buildings, etc.

Dr. Carlo Giraudi elected v-p in charge of research, development, and engineering for **Witco Chemical Co. Inc.,** New York, N. Y. His responsi-

COMPANIES . . . PEOPLE

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bilities extend to all of the Witco divisions and subsidiaries, both foreign and domestic.

Robert D. Eklund appointed Middle Atlantic dist. sales mgr., film operations of the Packaging Div., **Olin Mathieson Chemical Corp.** He will headquarter in Bala-Cynwyd, Philadelphia, Pa.

E. W. Vaill has been appointed tech. service consultant for **Union Carbide Plastics Co.**

P. Robert Young, formerly chief plastics engineer of Wallace & Tiernan Inc., has formed his own consulting business in Mamaroneck, N. Y., specializing in reinforced plastics with emphasis on "premix." He is a member of the exec. comm., Reinforced Plastics Div. of S.P.I.

Charles M. Hamilton Jr. named chief process engineer at **AviSun Corp.'s** new 75 million lb./yr. polypropylene plant at New Castle, Del. Mr. Hamilton has been serving in a similar capacity at AviSun's Port Reading, N. J. polymer plant.

Marwan R. Kamal joined the staff of **General Mills Central Research Laboratories,** Minneapolis, Minn., as project leader in the company's Polymer Research Dept.

Richard H. Orgass appointed sales rep., Eastern states, for **Extrudo-Film Corp.,** New York, N. Y.

James W. Cooley, previously Southern regional sales mgr., appointed to new post of asst. sales mgr. for **Lenox Plastics Inc.,** St. Louis, Mo.

Richard E. Durr appointed sales rep., Eastern regional sales territory, for Industrial Chemicals Div. of **Pittsburgh Chemical Co.,** with office at Paramus, N. J.

Victor E. Pierson, formerly sr. research chemist with U. S. Rubber Co., appointed tech. sales mgr. of **Anchor Adhesives Corp.,** Flushing, N. Y.

Charles M. Downey assigned to **Goodyear Aircraft Corp.'s** Plastic Sales dept. as staff rep.

Charles R. Widder joined the plasticizer group of the central research laboratory of **Archer-Daniels-Midland Co.,** Minneapolis, Minn.

Elmer G. Smith elected pres. of **American Plastics Corp.,** subsidiary of **Heyden Newport Chemical Corp.** He succeeds the late **John A. Parsons,** who died April 10.

Frederick K. Watson appointed export mgr. for the **Polyolefins Div.** of

Du Pont's Polychemicals Dept. In his new assignment, he will be responsible for foreign sales of Du Pont's Alathon polyethylene resin.

Frank M. Chapman named gen. mgr., Fluorocarbon Div., **Plastic & Rubber Products Co.,** Los Angeles, Calif. supplier of Teflon industrial parts.

Marvin Winemiller appointed works mgr., **Plastic Age Sales Inc.,** Saugus, Calif., in charge of production and mfg. for all divs.

Harold C. Steadman elected a dir. of **The Richardson Co.,** Melrose Park, Ill. mfr. of laminated and molded plastics, polystyrene resins, etc.

Robert E. Huffman, formerly sales engineer of **W. S. Shamban & Co.** in San Francisco, Calif., promoted to market development mgr. He will be located at the company's main offices in Culver City, Calif.

William G. Otto promoted to works mgr. of **Stanley Home Products Inc.,** Westfield, Mass., producers of plastic brush handles. He will also assume responsibility and direction for **Canford Mfg. Corp.** and **Klear Plastics Div.,** subsidiaries that are located at Canton, Pa.

Louis B. Allen appointed mgr., materials evaluation, Materials Laboratory, for **International Business Machines Corp.,** Endicott, N. Y. He joined the company in 1958 as an associate chemist.

William E. Coleman joined **J. T. Baker Chemical Co.,** Phillipsburg, N. J., as plastic sales engineer.

James P. Lillie appointed sales rep. for Philadelphia, Pa. branch of **Commercial Plastics & Supply Corp.,** New York, N. Y. **George C. Barber** named mgr. of the firm's Akron, Ohio warehouse and sales office.

Corrections

"Stability of thermoset plastics at high temperatures" (MPl, Feb. 1961, p. 136): The words "Epoxy" and "Polyester" on the curves in Fig. 3 should be interchanged.

"Blow molding fundamentals" (MPl, March 1961, pp. 105-110; 184-189): The helicoid flow deflector described in this article was designed and patented by John Royle & Sons, 10 Essex St., Paterson 3, N. J. (U. S. Patent 2,760,230).

"Reinforced molding compounds win new markets" (MPl, June 1961, p. 81): The captions for Photographs 1 and 2 were inadvertently transposed.

Ibid, p. 125: Caption should read: "Fig. 4: Inverted male drape: a) after sheet is heated in clamps and sags optimum amount, mold advances downward into sheet to seal edges; b) vacuum is applied, pulling sheet up against mold." Col. 3, Page 128: Change (Step B) to (Step A); change (Step C) to (Step B).—**End**

CLASSIFIED ADVERTISEMENTS

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Machinery and Equipment For Sale

SPRAY UP SYSTEM—Peterson Twin Tip gun, air operated chopper, 15' R. wall mtd. Chromolite boom, 2 Graco pumps & resin agitators. Pumps mtd. on 55 gal. drum cover. All hoses, regulators, fittings. System almost new. Cost $2950—Sell $1250. FOB Chgo., Schramm Plastics Corp., 1126 Holly Ct., Oak Park, Ill.

PLASTIC POLY-VINYL FOAM EQUIPMENT — Ovens, conveyors, mixers, rotational casting oven electronic heat sealers, votators, water chillers, box stitchers, sheet cutters, foam splitters, lab equip., lab testing equip. Midwestern location. Sparhawk Equipment Co. Inc., 7601 S. Paxton, Chicago 49, Ill. ESsex 5-3454.

FOR SALE—Baker-Perkins #16-UUEM, 150 gal. jacketed dispersion mixer, 150 HP XP drive, Vaulted cover; 100 gal. Baker Perkins T347SS jacketed dispersion blade mixer; Baker-Perkins 200 gal. jacketed sigma-blade mixers; 200 gal. and 500 gal. stainless jacketed reactors; 1350 gal. T347 stainless jacketed resin kettle; American 42" x 120" dbl. drum dryer. ASME code, stainless trim; 2600 gal. T316 stainless pressure tanks, coils, dished heads; 1800 gal. T316SS jacketed and agit. resin kettle; 800 sq. ft. T316SS shell and tube heat exchangers; Baker-Perkins #15-UUMM, 100 gal. jktd. dispersion blade mixer, 100 HP; Worthington 70 cu. ft. rotary blender; we pay cash—top dollar—for surplus equipment. Perry, 1429 N. 6th St., Phila. 22, Pa.

INJECTION MOLDING—HPM 9 oz; Hydraulic Press, French oil semiautomatic 100 ton; Mill-Farrell 16x36; Baker Perkins SS 100 Gal 2 Arm Jac. vac. Hyd. tilt 50 HP; 150 Gal Day Imperial Sigma; 3 Baker Perkins 100 Gal Sigma Jac. Hyd. tilt; SS tanks-2-11,000 gal-1-5700 Gal; Extruder 8" elec. heated; Ram extruder: Machinecraft Corp., 800 Wilson Ave., Newark, N. J. MI-2-7634.

FOR SALE—1 Hartig 2" electrically heated plastics extruder; 2 Stokes model 741—50 ton automatic molding presses; 2 Dunning & Boschert 300 ton compression molding presses; 1 Readco 190 cu ft stainless steel jktd. ribbon blender; 2 Ball & Jewell rotary cutters, #1 and #½ 10-15 HP. Chemical & Process Mach. Corp., 52 9th St., Bklyn. 15, N. Y. HY 9-7200.

BLOW MOLDING MACHINES HONG KONG—Unused machine three inch extruder, 2 sta. del. N.Y. duty paid only $4000.00. Others from $2200.00 to $5700.00. Molds Injection and Blow Molds. Constructed to spec very low prices. Exclusive U. S. dist. for machinery and molds. Kroll Trading Co., 133 Greene St., NYC. OR 4-1414.

MOST MODERN PACKAGING AND PROCESSING MACHINERY — Available at Great Savings. Baker Perkins, W. & P. and Day Double Arm Steam Jacketed Heavy Duty Mixers—25, 50, 75, 100, 150 and 200 gal. capacities. Day, Robinson 50 to 10,000 lbs. Dry Powder Mixers, Jacketed and Unjacketed. Also wood and Enamel. H. K. Porter 650 gal. Steam Jacketed Double Spiral Mixers. B. P. 100 gal. Jacketed Stationary Vacuum Double Arm Mixer. Day Imperial 75 gal. Double Arm Mixer, Sigma, Dispersion Blades. Mikro Model 6, Stainless Steel Atomizer with Collector. Mikro Pulverizers, Models Bantam, 1SH, 2TH, 3TH and 4TH. Fitzpatrick Models D, K-7 and K-8 Stainless Steel Comminuters. Colton Models 241 and 260 Double Rotary High Speed Tablet Presses. Stainless Steel Jacketed Mixing Kettles 100 and 150 gal. capacities. Package Machinery, Hayssen, Scandia, Wrap King, Campbell, Miller Wrappers. Cartoning Machines—Ceco, Pneumatic Scale, Jones. Union Standard Equipment Co., 318 Lafayette St., New York 12, N. Y. Ph: CAnal 6-5333.

FOR SALE—1¼" Vertical Extruder (Thermoplastic Processes Co.) new condition; head and dies available also. 14" Pelletizer (Cumberland Engineering Co.) on casters, 5 HP, like new. 25 Ton Laboratory Press (M & N)—12" x 12" electrically heated platens, like new. 1" Extruder (Farrel Birmingham)—short barrel, 3 HP drive. Park Industries, Inc. 450 Commercial Ave., Palisades Park, N. J. Phone: WIndsor 4-6616.

CHOICE EQUIPMENT PRICED FOR IMMEDIATE DISPOSAL—F-B Banbury Mixers Model #00, No. 11. F-B Unused 2 Roll Mills; 14"x30": Uni-Drive. F-B 2 Roll Mills 18"x54"; 22"x60". F-B 3 Roll Calender 22"x60" Complete. Hartig 4½" and 6" Electrically Heated Extruders, Vented, complete with Drives. NRM 2½" Oil Heated Extruder with Vari-Speed Drive, and Cumberland Pelletizer. Welding Engrs. 2" Twin S/S Screws; Oil Htd. Royle 2" Electr. Heated with Crosshead. NRM 1½" Jktd. with Crosshead; Vari-Drive. Davis-Standard 3¼" Wire Insulation Set Up with Extruder, Crosshead, Capstan, etc. Davis-Standard 2" Wire Set Up, same as above. B. & J. Rotary Cutters, Lab. #1 and #2. 4 Stokes 150 Ton Self Contained Molding Presses, complete with all accessories. Other Presses from 7 Ton to 500 Ton. Preform Presses, Autoclaves, Ball Mills, New Ribbon Blenders, Centrifuges, Dryers. Inquire about the FMC Rental-Purchase Plan. First Machinery Corp., 209-289 Tenth St., Brooklyn 15, N. Y., ST. 8-4672, Cable "Effemcy."

INJECTION MOLDING MACHINES—1 oz. Van Dorn, 2½ oz. Van Dorn, Fully Automatic, 4 oz. Moslo, 4 oz. Reed Prentice, 4 oz. Harvey, 8 oz. Reed Prentice, 12 oz. DeMattia, 12 oz. Reed Prentice, 16/20 oz. Reed Prentice. All in Stock. Immediate Delivery. 2200 Ton Birdsboro Heavy Duty Laminating Presses. Bed size 7' by 5'. Each press contains two 25" diameter rams. Complete with intensifiers for 4000 P.S.I. Stokes Model R Single Punch Tablet Press, with vari speed drive. 6" Hartig Extruder, 16.5:1 Electrically Heated Barrel. Complete with all controls and motor drive. 1" NRM Lab Extruder, complete with drive and controls. Scrap Grinders—1½ HP up to 50 HP available. We have a full line of Laminating Presses, Molding Presses, Mills, Calenders, Extruders, Injection Molders, Scrap Grinders, Coating Equipment and other accessories for the Plastic Industry. We Will Finance. Johnson Machinery Co., 90 Elizabeth Ave., Elizabeth, N. J. ELizabeth 5-2300.

FOR SALE—Model M420C Wink Universal Cutting Machine. Continuous or intermittent cutting. Motors 2 H. P. and 1/16 H.P. TEFC, 440-3-60, Model M226A Loop speed control unit. Hold down rolls, Hugger rolls. New in 1959. Reply Box 6946, Modern Plastics.

FOR SALE—Dillon Dynamometer 1957 Model L Tester complete with motorized drive and other fixtures. Practically new. Write Box 6965, Modern Plastics.

FOR SALE—500 ton W-S hobbing press. 500 ton Utility five 48"x30" platens. Four 300 ton Molding Presses various makes. HPM 200 ton downstroke. Watson Stillman 240 ton, ten 24"x56" platens. W & W 200 ton, 24"x42". Stokes Standard 50 ton semi-automatic. D&B 150 ton, 25"x25". French Oil 120 ton self-contained. 120 ton upstroke, 29"x21". 50 ton Birdsboro 24"x20" Stokes 15 ton automatics. Hydraulic pumps and accumulators. MPM 3½" wire covering Extruder. New ¾" plastic extruder. Other sizes to 6". Banbury #3 Mixer. Seco 6"x12" 2-roll Mills and Calenders. Farrel & Thropp 40" & 48". Other sizes to 60". 60" Spreader Heads with XP motors. Despatch electric heated ovens and other types. New ¾ oz. Bench Model Injection Machines. Van Dorn 1 and 2 oz. Other sizes up to 100 oz. Baker-Perkins and Day jacketed Mixers. Taylor-Stiles Pelletizer, 3 HP. Plastic Grinders. Stokes & Colton Preform Machines. Partial listings. Send for Bulletin #192. We buy your surplus machinery. Stein Equipment Co., 107-8th Street, Brooklyn 15, New York. STerling 8-1944.

PLASTIC EQUIPMENT—Extruder—4½" Hartig electrically heated. 40 HP-DC drive. Injection machine—2½ oz. Moslo 74-7. Blow mold—Negri 2 head. Dual reel wire take-ups. Hartig 2 H.P. Stokes compression mold mach. automatic 15 ton, model 800. Cumberland 18" Chopper 20 H.P. 6" Chopper, 1 H.P. All in good condition. Reasonable. Contact Ted Baum, OL 6-2020, Rego Insulated Wire Co., 830 Monroe St., Hoboken, N. J.

Machinery Wanted

MACHINERY WANTED—Approx. 4½" to 6" Extruder for pelletizing or might consider machine suitable for blow molding. Prefer late model. State Make, Serial #, Year of Manufacture and L:D Ratio. Reply Box 6968, Modern Plastics.

WANTED BY PLASTIC MOLDER—Used 16 to 32 ounce late model Watson-Stillman Injection Press. Reply Box 6964, Modern Plastics.

PRE-HEATER WANTED—Small used unit similar to Mytron Model CF 1 KW. Any condition. Advise price, working area, power and voltage. Send photo if possible. Box 6959, Modern Plastics.

WANTED—Second hand drying oven for nylon. Reply Southern Plastics Engineering Corp., Greensboro, N. C.

Materials For Sale

FOR SALE—15,000 lbs. white C/A pellets, also standard colors; Butyrate, standard colors; 20,000 lbs. virg. standard medium blue high impact; 8,000 lbs. virgin standard yellow high impact; 20,000 lbs. virgin white medium impact P/S; reprocessed ABS polymer colors and black. Reply Box 6973, Modern Plastics.

Materials Wanted

WANTED—PLASTICS OF ALL KINDS—virgin, reground lumps, sheet and reject parts. Highest prices paid for styrene, polyethylene, acetate, nylon, vinyl, etc. We can also supply virgin and reground materials at tremendous savings. Address your inquiries to: Goldmark Plastic Compounds, Inc. 4-05 26 Ave. Long Island City 2, N. Y. RA 1-0880.

GET THE TOP MONEY FOR PLASTIC SCRAP—Now paying top prices for all thermoplastic scrap. Wanted: polystyrene cellulose, acetate, vinyl, polyethylene, butyrate, acrylic nylon. All types and forms including rejects and obsolete molding powders. Fast action wherever you are located. Write, Wire, Today! Reply Box 6966, Modern Plastics.

Molds Wanted

WANTED—Used injection molds for table top and transistor radio cabinets. Reply Box 6969, Modern Plastics.

Help Wanted

WANTED—Production Manager for growing injection and compression molder of custom and proprietary items. Man we are seeking must be qualified to initiate and follow through on cost reduction and quality control procedures. Plant located 200 miles from N.Y.C. Send resume, salary requirements, Box 6963, Modern Plastics.

MOLDING FOREMAN WANTED—AAA1 company, located in southern Michigan, has excellent opportunity for foreman to take charge of 3rd shift in injection and blow-molding department. Proprietary shop with year round employment, steady advancement, pleasant small town location near Indiana border. Write qualifications and past earnings to Box 6961, Modern Plastics.

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EXTRUDER FOREMAN—Growing national packaging company is seeking experienced production-minded foreman to head extruder department in midwestern plant. The man should have three or more years in polyethylene extrusion or lamination, be in his thirties, and desire more money, more responsibility and more opportunity. This position offers an excellent starting rate, complete employee benefits and both short and long range growth opportunities. Write Box 6975, Modern Plastics, with full details of background, education, experience, compensation requirements. All replies treated with utmost confidence.

COST ESTIMATOR—Leading midwest custom plastic molder has opening for cost estimator thoroughly familiar with plastic molding, including injection, compression, and blow molding, and all phases of plastic finishing including decorative finishing. Relocation expenses paid. Salary commensurate with experience and ability. Send complete resume to Box No. 6973, Modern Plastics.

CHEMICAL ENGINEER-PRODUCT AND MARKET DEVELOPMENT—One of the country's large diversified manufacturing and sales corporations needs Chemical Engineer with background in resins and polyurethane foams for investigation of new markets, new product development, and materials application. Send resume of experience, earnings, and career goals to Box 6972, Modren Plastics.

TOY DESIGNERS—Expanding, design section of large toy mfgr., NY Metropolitan Area, offers rare opportunity to talented, experienced, energetic, responsible, imaginative Stylist-Designers, capable of developing with a minimum of supervision: complex toy projects from initial concepts thru "blue-sky" renderings, drafting-detailing, and model-expediting stages. Only those with high degree initiative, mature design talent, and teamwork sense should reply. Box No. 6971, Modern Plastics.

EXTRUDER—THERMO PLASTICS. Position open, man, experienced extrusions and related machinery. Excellent opportunity, growth potential, qualified man. Interviews confidential. H. G. Jacobs Mfg. Co. Paterson, N. J. AR 4-7640.

SALES ENGINEER—Expanding Florida corporation utilizing large blow-molding machines of capacity to 80 gallons desires aggressive personnel to develop custom sales. Ability to quote custom work and travel extensively desirable. All replies will be held confidential. Reply Box 6957, Modern Plastics.

WANTED YOUNG MAN, under 30, with technical background and knowledge of plastics industry for sales development position with progressive, fast-growing chemical firm basic in urethane elastomer technology and analogous materials. Working knowledge of thermoplastics processing methods preferred. Send resume in confidence to: Director of Personnel, Mobay Chemical Co., Penn Lincoln Parkway West, Pittsburgh 5, Pa.

Situations Wanted

GROWING IN THE PLASTICS FIELD? Versatile Engineer offers sound 10-yr. background in thermoplastics, engineering and sales, to aid your growth in plastic product or resin field. Ability to handle process, product or market development or production management. Seeking challenging position with opportunity based on performance. Age 32. Reply Box 6974, Modern Plastics.

MANUFACTURERS AGENT desires additional line allied to rubber and plastic industry. Now covering Ohio, soon to go into Michigan with line of mold lubricants and release agents. Reply Box 6956, Modern Plastics.

MANAGEMENT — Chemical Engineer. Eighteen years proven accomplishments as plant manager, assistant plant manager, plant superintendent, production superintendent, head of quality control, head engineering dept. Experienced chemicals, fats and oils, foods, monomeric and polymeric plasticizers-esters, fatty acids, alcohols, sulfuric acid, adhesives, vitamins, dry-wet milling. Reply Box 6962, Modern Plastics.

PLASTICS ENGINEER. M.S. degree in Chemical Engineering. 10 years extensive extrusion experience in die and machine design, compounding, production, development, and sales of film, pipe, sheet, profiles, etc. Want responsible position with future. Advise salary range. Reply Box 6960, Modern Plastics.

Business Opportunities

NEED MORE SALES-POWER? If your products are marketed to industrial users of plastic molding compounds and/or custom plastics molders, here is an unusual opportunity to gain added, top-flight sales representation. We are manufacturers of a nationally accepted and unique line of injection-molding compounds. Our sales organization is made up of men who are young and aggressive, yet who are technically oriented and thoroughly field-proven. They cover the nation's major industrial markets. Because these men are capable of expanding their sales effort to accommodate a few more selected product lines, you are invited to write us regarding your sales interests. If your products fit into our marketing pattern, you will be assured of adding a "sales force" second to none in its field. Reply to Box 6958, Modern Plastics.

SALE OF X-RAY FILM RECLAIMING PLANT, well established, fully equipped, with all technical data and trade secrets. Can be moved to any location in the States or abroad. Reply Box 6967, Modern Plastics.

LARGE NATIONALLY KNOWN houseware manufacturers interested in getting together with company that has ample blow molding equipment. If you are a substantial company, well financed, and have excellent facilities for producing large quantities of all types of blow molded proprietary items—and can warehouse and ship for us, then write Box 6970, Modern Plastics.

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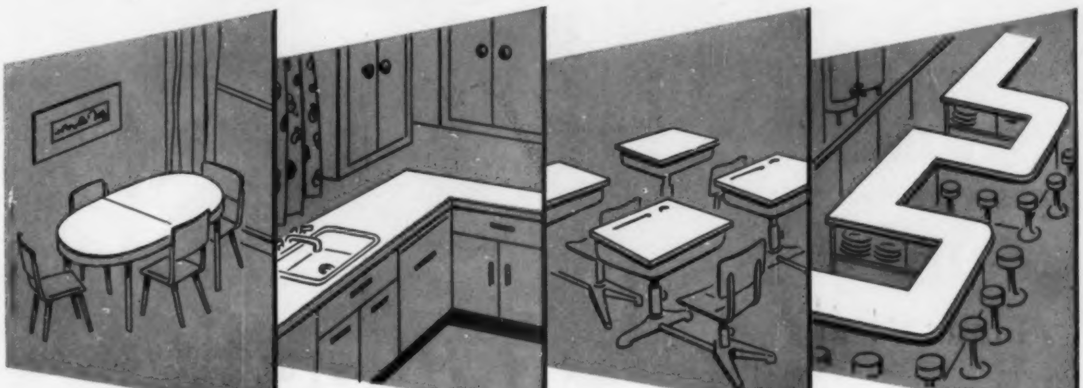

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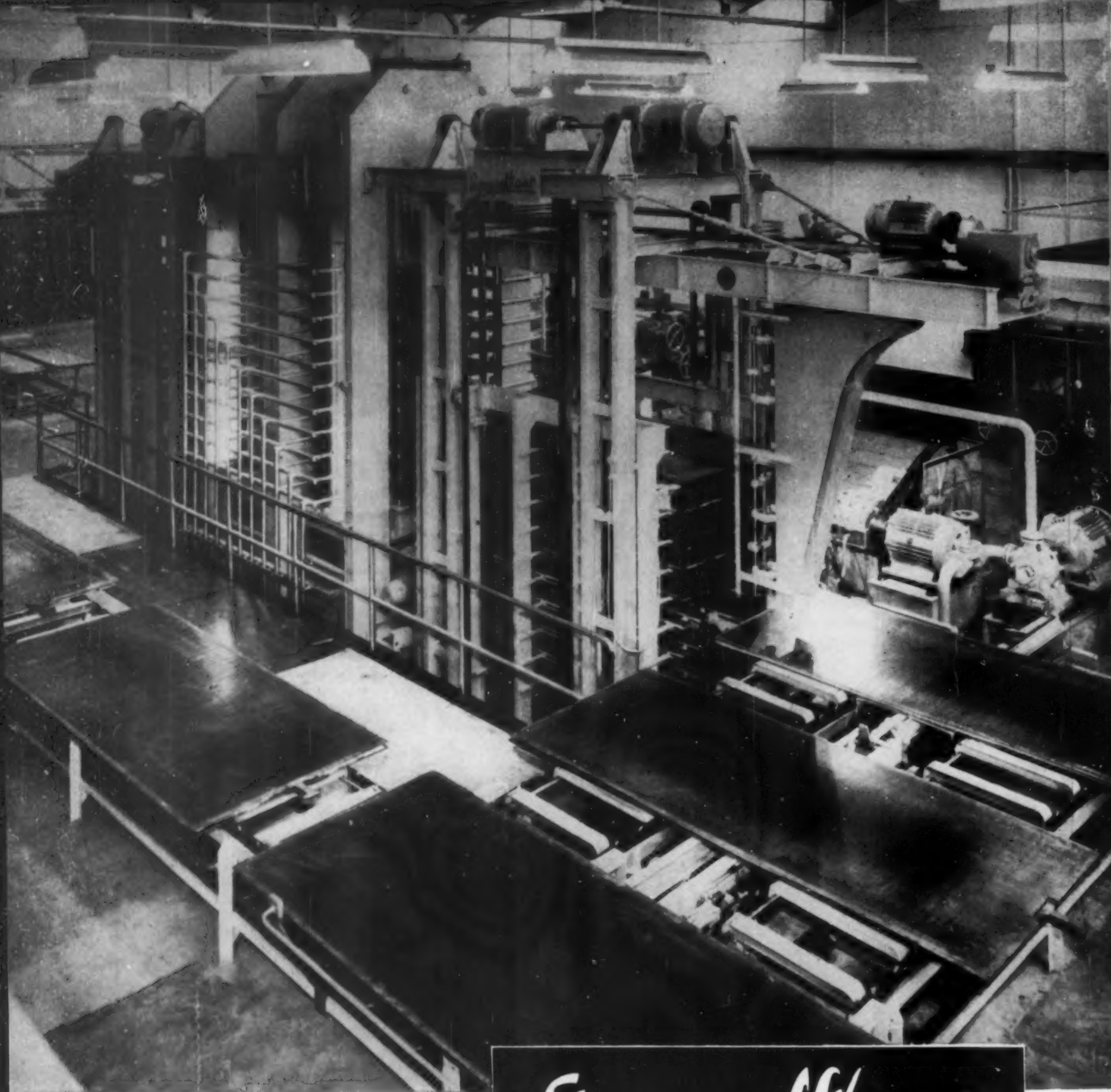

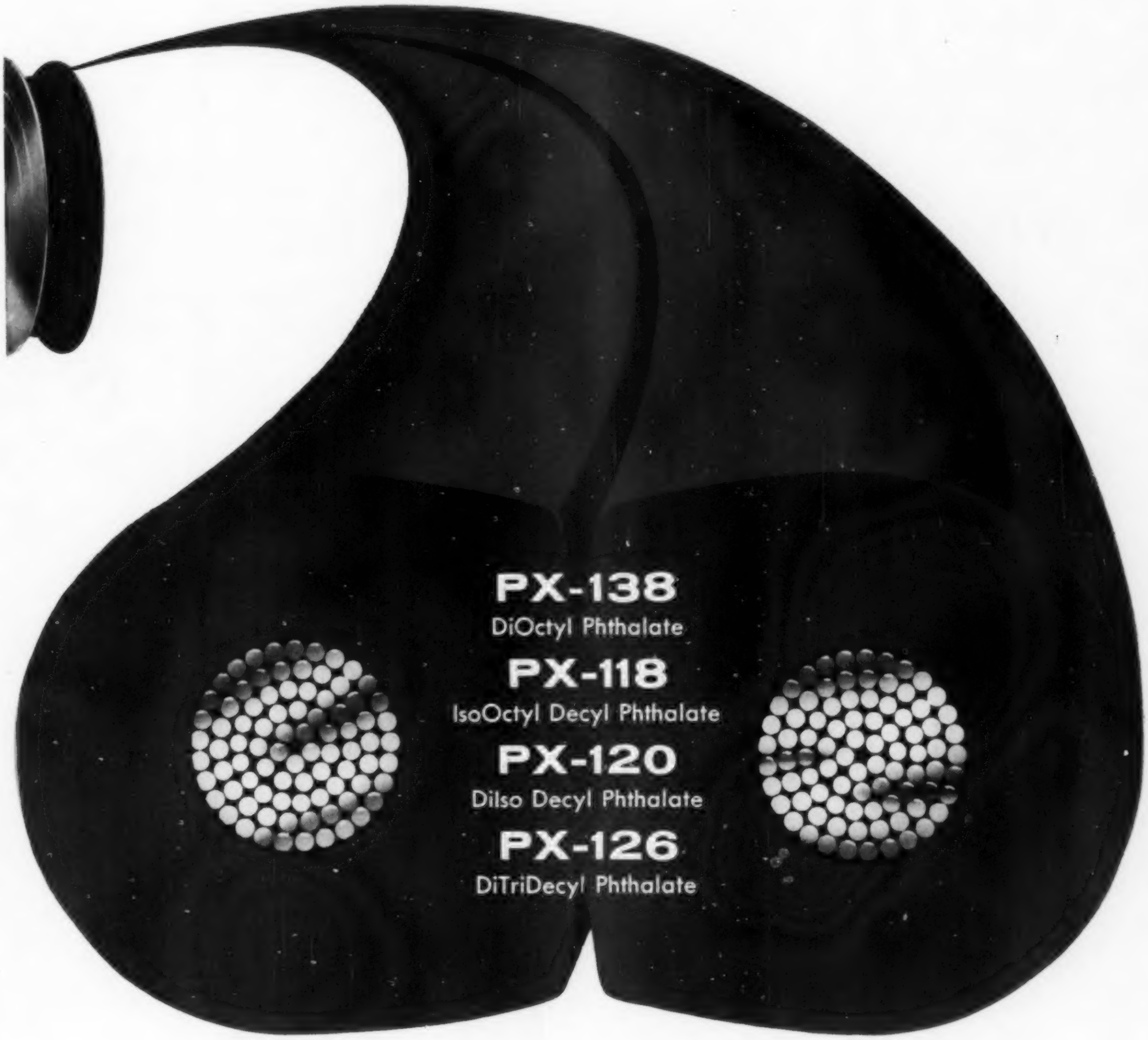
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